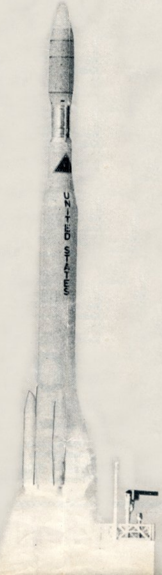
amateur radio

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA

JANUARY, 1973

Registered at G.P.O., Melbourne, for transmission by post as a periodical Category "B"

Price 40 Cents



Latest on Oscar 6

L.P. Filter

G5RV

Modern Filters

AMATEUR CRYSTALS

VHF BAND — 144 MHz. FM

HC6 Holders, ½ inch spacing

Channel A	Transmit	4,051.55 kHz.
	Receive	10,275.35 kHz.
Channel B	Transmit	4,055.5 kHz.
	Receive	10,285.71 kHz.
Channel C	Transmit	4,059.61 kHz.
	Receive	10,296.14 kHz.
Channel Z	Transmit	4,048.88 kHz.
	Receive	10,411.55 kHz.
Channel 4	Transmit	4,066.66 kHz.
	Receive	10,278.57 kHz.
Channel 1	Transmit	4,058.33 kHz.
	Receive	10,257.14 kHz.

Price $5.50 each

MARKER CRYSTALS

100 kHz. Marker	$12.00
1,000 kHz. Marker	$12.00
3,500 kHz. Marker	$5.50
5,500 kHz. Marker	$5.50

COMMERCIAL FREQ. CRYSTALS

HC6 Holders, ½ inch spacing

2,182 kHz.	2,637 kHz.	4,535 kHz.
2,524 kHz.	2,739 kHz.	6,280 kHz.
2,603 kHz.	2,979 kHz.	6,735 kHz.
	4,095 kHz.	

Price $5.50 each

LOW PASS FILTERS

A "Cabena" Low Pass Filter will fix TVI. Cut-off frequency 30 MHz.; attenuation at 60 MHz. better than 30 dB.; Insertion loss, negligible. Impedance 50-72 ohms.

Price $12.90, Postage 10c

AUTO CAR AERIALS

Hirschmann, Type 300N, side mounting, new.

Price $4.50, Postage 20c

INSTRUMENT CASES

Sloping front panel. Plastic case, metal front panel, 7¼ x 4¼ x 5 inches. Suitable for radio, test equipment, projects, etc.

Price $3.50 inc. S.T., Postage 10c

AC ADAPTOR—BATTERY SAVER

Type PS64—240v. to 4.5, 6, 7.5, 9v., 300 mA.	$14.50
Type PS62—240v. to 6 or 9v., 100 mA.	$9.50

Postage 30c.

SOLDERING IRONS

ADCOLA M70 1/8 inch tip, 240 volt	$8.00
ADCOLA M64 3/16 inch tip, 240 volt	$8.40
SCOPE 4 volts AC/DC, 100 watts	$6.40
MINISCOPE	$6.00
SCOPE De Luxe	$7.00

Postage 20c.

SOLDERING IRON TRANSFORMER

240 volts/3.3 volts, 100 V/A.	$6.40

Postage 40c.

RESIN SOLDER

Five-Core, 60/40	$2.50
Five-Core, 40/60	$2.20
Solder Pack, 42 inches	18c

BURGLAR ALARM SIREN

6 Volt. Suit Burglar Alarms, Boats, Fire Brigades, etc. Complete with mounting bracket. Available in 12 volt.

Price $10.50 each

TRIO COMM. RECEIVER

Trio Model 9R59DE, four bands covering 540 kHz. to 30 MHz., two mechanical filters for maximum selectivity, product detector for SSB reception, large tuning and bandspread dials for accurate tuning, automatic noise limiter, calibrated electrical bandspread, S meter and BFO, 2 microvolts sensitivity for 10 dB. S-N ratio.

Price $185.00

TRADE-IN ACCEPTED

1 WATT TRANSCEIVER

13 transistors, 3-channel, and call system. Specifications: 13 transistors, 1 diode, 1 thermistor. Range up to 10 miles (depending on terrain, etc.). Frequency 27.240 MHz. (P.M.G. approved with licence). Freq. stability: plus or minus 0.005%. Transmitter: Crystal controlled, 1 watt. Receiver: Superheterodyne, crystal controlled. Antenna: 13 section telescopic. Power source: eight UM3 1.5 volt pen batteries. Size: 8¼ x 3¼ x 1¾ inches. Weight: 25 ozs. Other features: Leather carrying case, battery level meter, squelch control, earphone jack, AC adaptor jack, etc.

Price $79.50 a Pair

Single units available, **$40 each.** Be early.

CLEARANCE SALE OF
ELECTRONIC EQUIPMENT AND COMPONENTS

Receivers, transceivers, ex-Army, and citizens band transmitters, test equipment, oscilloscopes, signal generators, multimeters, chassis racks, panels, computer parts and boards, power transformers up to 6.6 kv., valves, transistors, potentiometers, etc., speakers, amplifiers, cables—hook-up and co-axial 50 and 70 ohms, multicore up to 50 core—panel meters, AVO meters, valve testers and all types of electronic components.

7,000 sq. ft. of electronic gear, plenty of parking—come and inspect. Open 10-5 p.m. week days, 9.30-12 Saturday morning.

Wanted to buy: Receivers, transceivers, electronic equipment and components. Top prices paid.

PRINTED CIRCUIT TAB POTS

Values available: 500 ohm, 1K, 2K, 5K, 10K, 25K, 50K, 100K, 250K, 500K ohms, 1 and 2 megohms. Type "A".

Price 32 Cents each

HAM RADIO

(DISPOSAL BRANCH)

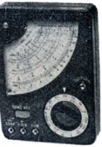
104 Highett St., Richmond, Vic., 3121

Phone 52-8136

MULTIMETERS

MODEL 200-H — Price $12.50

20,000 ohms per volt d.c., 10,000 ohms per volt a.c.



Specifications:
D.C. volts: 0-5, 25, 50, 250, 500, 2500.
A.C. volts: 0-10, 50, 100, 500, 1000.
D.C. current: 0-50 uA.; 25, 250 mA.
Resistance: 0-60,000 ohms; 0-6 meg.
Capacity: 0.01 - 0.3 uF. (at A.C. 5v.); 0.0001-0.01 uF. (at A.C. 250v.).
Decibel: Minus 20 db., plus 22 db.
Output range: 0-10, 50, 100, 500, 1000.
Battery used: UM3 1.5v., 1-piece.
Dimensions: 3¼ x 4½ x 1⅛ inch.
With internal battery, leads, prods.

MODEL AS-100D/P — Price $34.50

High 100,000 ohm/volt sensitivity on DC. Mirror scale, protected movement.
AC volts: 6, 30, 120, 300, 600, 1200 (10K o.p.v.). DC volts: 3, 12, 60, 120, 300, 600, 1200 (100,000 o.p.v.). DC current: 12 uA., 6 mA., 60 mA., 300 mA., 12 amps. Resistance (ohms): 2K, 200K, 20M, 200M. dB. scale: minus 20 to plus 63 dB. Audio output (volts AC): 6, 30, 120, 300, 500 1200. Battery: internal. Approx. size: 7½ x 5½ x 2¾ inches.

MODEL OL-64D — Price $19.75

20,000 ohms per volt. DC volts: 0.025, 1, 10, 50, 250, 500, 1000 (at 20K o.p.v.), 5000 (at 10K o.p.v.). AC volts: 10, 50, 250, 1000 (at 8K o.p.v.). DC current: 50 uA., 1 mA., 50 mA., 500 mA., 10 amps. Resistance (ohms): 4K, 400K, 4M, 40 megohms. dB scale: minus 20 to plus 36 dB. Capacitance: 250 pF. to 0.02 uF. Inductance: 0-5000 Henries. Size: 5¾ x 4¼ x 1¾ inches.

MODEL C1000 — Price $6.95

This is the ideal low-cost pocket meter. AC volts: 10, 50, 250, 1000 (1000 o.p.v.). DC volts: 10, 50, 250, 1000 (1000 o.p.v.). DC current: 1 mA., 100 mA. Resistance (ohms): 150K. dB. scale: minus 10 to plus 22 dB. Dimensions: 4¾ x 3¼ x 1¼ inches.

MODEL CT-500/P — Price $16.75

Popular, medium-size, mirror scale, over-loaded protected. AC volts: 10, 50, 250, 500, 1000 (10K o.p.v.). DC volts: 2.5, 10, 50, 250, 500, 5000. DC current: 50 uA., 5 mA., 50 mA., 500 mA. Resistance (ohms): 12K, 120K, 1.2M, 12M. dB. scale: minus 20 to plus 62 dB. Approx. size: 5½ x 3½ x 1¾ inches.

MODEL A-10/P — Price $55.00

Giant 6½ inch meter. In-built signal injector, overload protected.
AC volts: 2.5, 10, 50, 250, 500, 1000 (10K o.p.v.). DC volts: 0.5, 2.5, 10, 50, 250, 500, 1000 (30K o.p.v.), 5000 (10K o.p.v.). DC current: 50 uA., 1 mA., 50 mA., 250 mA., 1 amp., 10 amps. AC current: 1 amp., 10 amps. Resistance (ohms): 10K, 100K, 1M, 100M. dB. scale: minus 20 to plus 62 dB. Signal injector: Blocking oscillator circuit with a 2SA102 transistor. Approx. size: 6½ x 7¼ x 3¾ inches.

HAM RADIO SUPPLIERS

323 ELIZABETH STREET, MELBOURNE, VIC., 3000

Phones: 67-7329, 67-4286 All Mail to be addressed to above address

Our Disposals Store at 104 HIGHETT ST., RICHMOND (Phone 42-8136) is open Mondays to Fridays, 10.30 a.m. to 5.0 p.m., and on Saturdays to midday.

We sell and recommend Leader Test Equipment, Pioneer Stereo Equipment and Speakers, Hitachi Radio Valves and Transistor Radios, Kew Brand Meters, A. & R. Transformers and Transistor Power Supplies, Ducon Condensers, Welwyn Resistors, etc.

amateur radio

JOURNAL OF THE WIRELESS INSTITUTE OF AUSTRALIA. FOUNDED 1910

JANUARY, 1973
Vol. 41, No. 1

Published monthly, as the official journal, by the Wireless Institute of Australia. Reg. Office: Above 474 Toorak Rd., Toorak, Vic., 3142.

Enquiries and material to:
The Editor, Phone (03) 24-8652.
P.O. Box 150, Toorak, Vic., 3142.

Copy is required by the **third of each month.** Acknowledgment may not be made unless specially requested. All important items should be sent by certified mail.

The Editor reserves the right to edit all material, including Letters to the Editor and Hamads, and reserves the right to refuse acceptance of any material, without specifying any reason.

Advertising:
Advertisement material should be sent direct to the Editor by **the 25th of the month preceding the month prior to publication.**

Hamads should be addressed to the Editor by the **third of each month.**

Printers:
"RICHMOND CHRONICLE"
Shakespeare Street, Richmond, Vic., 3121
Phone 42-2419.

CONTENTS

COVER

A dramatic photograph of the blast-off of the THOR-DELTA rocket which put Oscar 6 into orbit. Up-to-date information on Oscar 6 is included elsewhere in this issue.

QSP

RTTY, QRM AND YOU

Felt like QRMing one of those obnoxious r.t.t.y. signals lately? You haven't? Perhaps you don't go on the h.f. bands much these days. From Alf Chandler's Intruder Watch Report ("A.R.") it's obvious that r.t.t.y. constitutes the major part of the intruder QRM on the 14 MHz. band, and is far from negligible on the other h.f. bands. Some of these signals are particularly offensive as they occupy more bandwidth in the c.w. section of 20 metres than does the occasional s.s.b. non-gentlemen. Genuine amateur r.t.t.y. operators are pained but not too surprised when, in the middle of a choice DX contact an amateur c.w. operator opens up calling CQ on their space frequency.

Amateur r.t.t.y'ers are used to being blamed for QRM. Indeed, in the early days it was the Amateurs themselves and not the Australian Post Office who were instrumental in restricting amateur r.t.t.y. operation.

Fortunately as the true facts have become known, the official attitude and that of many Amateurs has undergone a radical change. R.t.t.y. has now become almost a respectable mode of operation and there are good reasons for this.

Firstly, amateur r.t.t.y. is extremely economical in its use of bandwidth. On the h.f. bands, the maximum permissable shift is 850 Hz., but nobody uses anything but narrow shift (170 Hz.) on the h.f. bands these days.

Secondly, on the basis of speed and accuracy, r.t.t.y. is probably the most efficient form of communication available and this is amply borne out by the ever increasing use of r.t.t.y. by commercial stations.

Thirdly, r.t.t.y. is one amateur field still dominated by the home-brewer. Sophisticated solid-state designs appear at frequent intervals in amateur journals and very few r.t.t.y. types have descended to using commercial demodulating equipment.

Fourthly, contrary to what might be expected, it isn't necessary to embezzle the firm's funds to get going in r.t.t.y. Some enthusiasts have paid up to $1,200 for a machine, but most amateurs use a Creed Model 7 or a Teletype Corp. Model 15 for which they pay around $50. And these will even double as electric typewriters around the home. The vast majority of r.t.t.y. circuitry uses conventional components, and my junk box supplies most of my needs.

Finally, amateur r.t.t.y. is progressive. Amateurs like Vic Poor, K6NO, and Iw Hoff, W6FFC, and, nearer home, Eric Ferguson, VK3KF, as well as many others, have continued to make contributions to the state of the art which are of commercial as well as amateur interest. Unattended operation is possible. Faster speeds (100 w.p.m.) are around the corner. Oscar 6 uses r.t.t.y. telemetry. Very slow speeds (down to 1 w.p.m or less) can, by data averaging, be used to achieve fantastic performances in the retrieval of signal from noise.

So, when you next feel the urge to QRM that r.t.t.y. signal, listen first and make sure it isn't one with the 170 Hz. warble which is a characteristic of amateur r.t.t.y. This one isn't doing you any harm. But get aboard and clobber the r.t.t.y. intruders in the amateur bands as much as you like. C.w. is okay for this but only if everybody lumbers the chap simultaneously. The catch is that r.t.t.y. electronics have been devised to defeat c.w. QRM. So why not join us and do a proper job on them by fighting r.t.t.y. with r.t.t.y.? It is very noticeable that during world-wide contests, intruders disappear from the r.t.t.y. section of our bands. There must be some sort of a moral to this, if I could only think what it was . . .

JIM GODING, VK3DM,
Member of W.I.A. Executive.

U.S.A. TELEPHONY EXTENSIONS

F.C.C. Docket 19162 squashed any fears that U.S.A. telephony stations could operate from 14150 kHz. instead of the present 14200 kHz. In the F.C.C. Report and Order on this, it was stated "certainly we would be short-sighted if we totally disregarded opinions such as that of the I.A.R.U., Region 1 Division, which pointed out (inter alia) 'The downward shift to 14150 kHz. will cause severe interference to operation in Region 1'. U.S. high power and large number of stations would render it impossible for foreign stations to operate above 14150 kHz. when U.S.A. stations are heard; would also upset I.A.R.U. Region 1 long established band plans."

R.T.T.Y.

"Considerable investment is being made in a Teleprinter Handbook as it is thought that there is a good market for a publication on this subject." R.S.G.B. Report of Council to members for 1972.

O.I.C's

"Anyone for a sked on 500 Terahertz?" asks Jim Fisk, the Editor of "Ham Radio" (Sept.) in connection with the development of optical integrated circuits which are closely related to laser communications.

OVERSEAS SURFACE MAILS

Mails from overseas by surface mail take some time to reach destination. Parcels posted from A.R.R.L. on 31st August reached the W.I.A. office on 17th November. Parcels from West Germany postmarked 21st September arrived on 16th November. A similar situation affects magazines sent by sea mail.

U.S.A.—AMATEUR STATIONS USED FOR NON-AMATEURS

Another interesting F.C.C. Report and Order (19245) quotes "The Commission believes that the best solution lies between the extremes of prohibiting entirely third party communication and permitting unlimited third party operations. To prohibit entirely third party traffic would tend to stifle one of the basic purposes of the Amateur Radio Service which is to provide a voluntary non-commercial radio service. But to allow all third party communications would tend to cause increased congestion in the Amateur bands . . . We are adding a new section, 97.114, which will both prohibit commercial third party traffic . . . it will not prohibit the use of the Amateur Radio Service on behalf of organisations such as the Eye Bank and the American Red Cross" (except for traffic on regular business affairs).

COSTS OF NATIONAL AMATEUR JOURNALS

The R.S.G.B. Accounts (Nov. "Radio Comm.") for the year ending 30/6/72 show the cost, including staff remuneration **and after deducting advertising revenue** of their journal "Radio Communication" as £33,245 (this is equivalent to about $69,000). Like "Amateur Radio", their journal is distributed free to members each month. The U.K. membership figures quoted by the I.A.R.U. for 1972 show 17,800 members (9,200 licensed) paying $US10.00 membership fee. On the same basis, "Amateur Radio" for the year 1972 was budgetted as costing the W.I.A. $13,225 (1972 Fed. Convention Minutes).

PHILATELY

CW enthusiasts will be pleased to note the design of the new 60c Pioneer Communications stamp.

U.S.A. REPEATERS

Yet another F.C.C. Docket 18803 (on v.h.f. repeaters) revised the definitions applicable to the Amateur Radio Service. "**Terrestrial location**" was defined as "Any point within the major portion of the Earth's atmosphere, including aeronautical, land and maritime locations." "**Fixed operation**" states "Radio communication conducted from the specific geographical land location shown on the station licence". "**Effective radiated power**" — "The product of the radio frequency power, expressed in watts, delivered to an antenna, and the relative gain of the antenna over that of a half-wave dipole antenna."

TX ON A CHIP

Announced in the U.S.A. through "CQ" (Sept.) and other mags. is the LP2000 IC which is capable of producing 100 mW. of r.f. power to an antenna and is less than 4/10ths inch diameter by 2/10ths inch high. Add a crystal, microphone and power supplies and you are in business.

OPTO - ELECTRONICS

Is the title of a short article in "S.W. Mag." for Sept. 1972. This covers Nixie tubes but goes on to describe LEDS of three varieties of gallium salts and liquid crystals, both of which operate from low voltages.

WEAK VOICES ON TAPE

Weak voices of unknown origin appearing as recordings on magnetic tape is now the subject of a book by G6RS, 32 Badminton Rd., Maidenhead, Berks, SL64QT, U.K. Anyone interested? ("Short Wave Mag.," Sept. 1972)

BUILDING MODERN FILTERS

PART THREE

By "CABBAGE-TREE NED"*

• The ripple filters exemplify the practical rewards of "modern" filter design.

A flat-filter (Butterworth) to give 30 dB. attenuation at 15 kHz. from a cut-off frequency of 10 kHz. would require nine elements. An equal-ripple (Chebyshef) low-pass would require only six elements—that means two less coils to wind. Moreover, the usable bandwidth is wider.

The complete-ripple (elliptic) filter can display the same virtues as to attenuation, **and**, by means of the in-built "rejection notch" just outside the pass-band, enables suppression of a necessary command signal from the wanted intelligence. The Zone envisages trying such a filter in a modification of its f.m. facilities.

USE OF THE TABLES

Certain quantities appear which need some comment, granted that our main concern is with **amount** of attenuation in the stop-band and sharpness beyond the chosen cut-off frequency.

Using standard symbols, the diagrams will explain the meaning of A_P, A_S, f_{co}, f_S, f_1 and f_2. Nevertheless, in words, the symbols mean:

A_P = Maximum attenuation in pass-band = ripple magnitude.

A_S = Minimum (required) attenuation in stop-band.

f_S = Frequency where minimum stop-band attenuation is first reached.

f_1 = First attenuation peak.

f_2 = Second attenuation peak with five-section filter.

The diagrams, note, have mostly been drawn with attenuation dB. up the axis, and the pass-band therefore is represented with a low value of attenuation. Hence the diagrams may appear upside down compared with the other (possibly more familiar) representation.

Reflection co-efficient (r%) and v.s.w.r. are shown because of their well known importance in r.f. circuits. It can be shown that r is related to ripple magnitude, increasing therewith, but at the same time allows greater choice of skirt-steepness.

Further, if we accept that at audio frequencies we can often tolerate reflection losses more easily, we have some flexibility in locating the peaks of attenuation in the stop-band.

The practical need is to place "rejection notches" where we want them. Since the basic design process is beyond our present scope, the Tables are compiled so that we can, as hinted in the last paragraph, sacrifice a desired value of pass-band ripple (hence of v.s.w.r.) in order to gain a degree of choice for the notch frequency. Thus, if we must place the notch on a given frequency, we can search the Tables for a notch frequency to suit and accept the then-available skirt-steepness or v.s.w.r.

* VK3ZRQ, A. G. Birch, 5 Harrison Street, Bendigo, Vic., 3550.

GENERAL COMMENTS

A later article deals with the winding of inductances for these filters using pre-gapped Philips P-Cores of one (the most useful) size. The cores are self-shielding and hence ease one part of the constructor's problem.

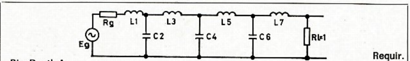
The Tables given can be used for either of the two ladder structures, T or Pi. However, some care is needed then in reading the column headings, and it is suggested that the data given be used only as indicated in connection with each Table.

Further, it is true that a given filter-prototype can be turned end-for-end if for instance it is needed that the source end be of high impedance and the output end be of low impedance. Again some care is needed.

It was felt that a useful, if slightly limited, tabulation would be more to the point than the complex of information which would have resulted with the more comprehensive possibilities suggested in the last two paragraphs.

Nevertheless, for the power-matched Tables 2 and 3, it is valid to use the pi-type schematic if desired, since for a 5th order elliptic filter (say) there would be only two coils to wind instead of five. Further, some workers have remarked that power-matched filters are easier to align, although they do involve some loss which is not present in voltage-source filters.

The figures in column 3 of the Tables may be deceptive because cut-off frequency is taken as that where the skirt falls past the ripple-dB. level, not the more familiar 3 dB. level. Thus for 0.1 dB. ripple and 70 dB. attenuation (Table 3), it apparently takes 1½ octaves beyond cut-off to reach —70 dB. In fact, a flat filter of the same (5th) order would have reached only about —30 dB. at the same frequency.



Rip. Depth A_P Reflect. r% v.s.w.r.	Order N	Ratio f_S/f_R	L1	C2	L3	C4	L5	C6	L7	Requir. dB. Atten. A_S
A_P = 0.01 dB.	3	3.3	0.239	0.228	0.094					18
r = 5%	5	2.2	0.246	0.286	0.261	0.197	0.078			30
v.s.w.r. = 1.1	7	1.9	0.248	0.297	0.297	0.281	0.249	0.256	0.456	45
A_P = 0.1 dB.	3	2.3	0.241	0.239	0.114					18
r = 15%	5	1.8	0.248	0.287	0.281	0.225	0.103			30
v.s.w.r. = 1.35	7	1.7	0.250	0.295	0.306	0.290	0.276	0.219	0.101	45
A_P = 0.5 dB.	3	1.8	0.250	0.242	0.148					18
r = 33%	5	1.6	0.259	0.277	0.306	0.241	0.144			30
v.s.w.r. = 2.0	7	1.5	0.262	0.283	0.324	0.284	0.306	0.240	0.142	45

EQUAL-RIPPLE LOW-PASS FILTERS
TABLE 1.—VOLTAGE SOURCE
(Units: L Henrys, C Farads)

Acknowledgment must be made to the publishers, John Wiley & Sons, for their ready permission to use small portions of Zverev's Handbook of Filter Synthesis in deriving the values of Tables 3 and 4 particularly. Much of the information as to flat (Butterworth) and equal-ripple filters is fairly easily obtained with quite ordinary use of Kirchhoff's Laws and standard mathematical equations. The process basically is to equate the L and C co-efficients in a Kirchhoff equation to corresponding numerical co-efficients in what are called Standard Butterworth and Chebyshef Polynomials.

The polynomial (flat Butterworth, or Chebyshef equal-ripple) filters are in general physically simpler since they consist only of inductors in the series arm and capacitors only in the shunt arm. The elliptic filters do provide steeper skirt-slopes, and useful rejection notches in the stop-band, at the price of slightly more complexity.

For the curious, useful added information can be found in any of the references in the short bibliography.

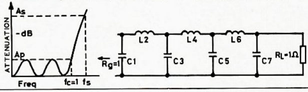
SAMPLE DESIGN No. 1

An equal-ripple low-pass audio filter is needed to have cut-off at 3.5 kHz. as a "steeper-skirt" replacement for the flat filter of the last paper. It is required to produce at least 30 dB. of

Rip. Depth A_P Reflect. r% v.s.w.r.	Order N	Ratio f_s/f_c	L1	C2	L3	C4	L5	C6	L7	Requir. dB. Atten. A_s
A_P = 0.01 dB.	3	3.3	0.238	0.240	0.238					18
r = 5%	5	2.2	0.156	0.268	0.346	0.268	0.156			30
v.s.w.r. = 1.1	7	1.9	0.145	0.254	0.320	0.298	0.320	0.254	0.145	45
A_P = 0.1 dB.	3	2.3	0.228	0.254	0.228					18
r = 15%	5	1.8	0.207	0.247	0.357	0.247	0.207			30
v.s.w.r. = 1.35	7	1.7	0.201	0.242	0.356	0.267	0.356	0.242	0.201	45
A_P = 0.5 dB.	3	1.8	0.297	0.204	0.297					18
r = 33%	5	1.6	0.287	0.208	0.429	0.208	0.287			30
v.s.w.r. = 2.0	7	1.5	0.284	0.206	0.432	0.220	0.432	0.206	0.284	45

Alternative Ladders for Table 2 only

1. The T-input scheme above Table 1, with column headings as given.
2. The Pi-type scheme here given, but now read the column headings from left-to-right starting with col. 4 as: C1, L2, C3, L4, C5, L6 and C7.



EQUAL-RIPPLE LOW-PASS FILTERS
TABLE 2.—POWER-MATCHED
(Units: L Henrys, C Farads)

attenuation at the frequency 5.5 kHz. The filter is to be driven from a voltage-source and work into a 600 ohm load.

Solution: Choose the filter with normalised values given in line 8 of Table 1, since with an f_s/f_{co} ratio of 1.6, the required 30 dB. will be achieved by the frequency 3,500 × 1.6 = 5.6 kHz., which would still be acceptable.

The element values are calculated as shown:

$$L1 = \frac{0.259 \times 600}{3500} = 0.0443 \text{ Henry} = 44.3 \text{ mH.}$$

$$L3 = \frac{0.306 \times 600}{3500} = 52.4 \text{ mH.}$$

$$L5 = \frac{0.144 \times 600}{3500} = 24.7 \text{ mH.}$$

$$C2 = \frac{0.277}{3500 \times 600} = \frac{0.277}{2.1 \times 10^6} = 0.132\ \mu\text{F.}$$

$$C4 = \frac{0.241}{2.1 \times 10^6} = 0.151\ \mu\text{F.}$$

SAMPLE DESIGN No. 2

To improve the tonal quality of the audio passed by the flat filter of the 2nd Paper or the equal-ripple equivalent just presented, we want a filter to cut-off at 6 kHz. and produce at least 40 dB. of attenuation before the frequency rises above 10 kHz. The filter is to work between 600-ohm terminations. It is also needed that the filter should reject two command-signals on frequencies which can be set within fairly flexible limits somewhere beyond cut-off in the stop-band.

Solution: The requirements suggest we choose the 5th order elliptic filter which will have the required two infinite-rejection notches built-in to the stop-band, and provide power matching.

For the relatively small value of A_s = 40 dB., we can choose normalised element values in Table 3 from any one of lines 4, 8, 12 or 15.

Line 4 would almost satisfy both frequency and attenuation requirements with only A_P = 0.01 dB. ripple. However, we choose to have a margin, and settle for A_P = 0.1 dB. and find the frequency need easily satisfied, while still having v.s.w.r. = 1.35 only.

The element values thus become:

$$L1 = \frac{0.16 \times 600}{6000} = 0.016 \text{ Henry} = 16 \text{ mH.}$$

$$L2 = \frac{0.0275}{10} = 0.00275 \text{ Henry} = 2.75 \text{ mH.}$$

$$L3 = \frac{0.252}{10} = 25.2 \text{ mH.}$$

$$L4 = \frac{0.085}{10} = 8.5 \text{ mH.}$$

$$L5 = \frac{0.121}{10} = 12.1 \text{ mH.}$$

$$C2 = \frac{0.189}{6000 \times 600} = \frac{0.189}{3.6 \times 10^6} = 0.0525\ \mu\text{F.}$$

(0.047 in parallel with 0.0047 µF.)

$$C4 = \frac{0.138}{3.6 \times 10^6} = 0.0384\ \mu\text{F.}$$

(say 0.039 µF.)

(This could have been a voltage-source design in fact, but our Tables are necessarily of limited scope, and power matched filters do have their virtues.)

SAMPLE DESIGN No. 3

An r.f. filter is required for harmonic suppression at the output of a typical h.f. s.s.b. transmitter operating below 30 MHz., and into a 50-ohm impedance. The filter must produce between 40 and 50 dB. of attenuation before the frequency 50 MHz. is reached.

Solution: Since there is no requirement for rejection notches, we could use an equal-ripple filter from Table 2. However, Table 3 gives more flexibility, and choosing to tolerate 15% reflection (a v.s.w.r. of 1.35), we could obtain our 50 dB. from line 7 of the Table and find the element values as listed below:

$$L1 = \frac{0.168 \times 50}{30 \times 10^6} = \frac{0.168}{0.6 \times 10^6} = 0.28\ \mu\text{H.}$$

(9 turns, 1½" long, ½" diam.)

$$L2 = \frac{0.0172}{0.6 \times 10^6} = 0.0287\ \mu\text{H.}$$

(2 turns, ½" long, ½" diam.)

$$L3 = \frac{0.273}{0.6 \times 10^6} = 0.455\ \mu\text{H.}$$

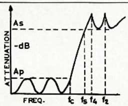
(12 turns, 1¼" long, ½" diam.)

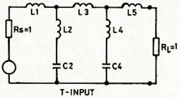
$$L4 = \frac{0.049}{0.6 \times 10^6} = 0.082\ \mu\text{H.}$$

(4 turns, 1" long, ½" diam.)

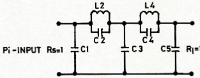
$$L5 = \frac{0.143}{0.6 \times 10^6} = 0.24\ \mu\text{H.}$$

(8 turns, 1¼" long, ½" diam.)



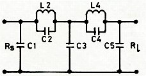


Rip. Depth A_P Reflect. r% v.s.w.r.	A_S Desired Min., Atten. Required at f_S	L1	L2	C2	L3	L4	C4	L5	$\frac{f_S}{f_C}$	Notches $\frac{f_4}{f_C}$	$\frac{f_2}{f_C}$
A_P = 0.01 dB.	70	0.118	0.005	0.203	0.242	0.013	0.191	0.111	3.07	3.22	5.13
r = 5%	60	0.117	0.008	0.200	0.236	0.021	0.181	0.104	2.56	2.68	4.24
v.s.w.r. = 1.1	50	0.113	0.011	0.196	0.230	0.032	0.168	0.096	2.06	2.16	3.36
	40	0.108	0.018	0.189	0.219	0.055	0.147	0.081	1.70	1.77	2.71
A_P = 0.1 dB.	70	0.176	0.007	0.212	0.297	0.018	0.197	0.166	2.56	2.68	4.24
r = 15%	60	0.173	0.011	0.206	0.287	0.030	0.184	0.157	2.06	2.16	3.36
v.s.w.r. = 1.35	50	0.168	0.017	0.200	0.273	0.049	0.166	0.143	1.70	1.77	2.71
	40	0.160	0.028	0.189	0.252	0.085	0.138	0.121	1.41	1.46	2.17
A_P = 0.18 dB.	70	0.201	0.008	0.205	0.318	0.022	0.191	0.188	2.37	2.48	3.90
r = 20%	60	0.197	0.013	0.202	0.306	0.035	0.178	0.178	1.94	2.02	3.14
v.s.w.r. = 1.5	50	0.192	0.020	0.195	0.290	0.055	0.160	0.163	1.62	1.69	2.57
	40	0.182	0.032	0.184	0.266	0.095	0.133	0.139	1.37	1.41	2.07
A_P = 0.28 dB.	60	0.220	0.014	0.195	0.326	0.038	0.172	0.200	1.89	1.97	3.04
r = 25%	50	0.213	0.023	0.187	0.303	0.065	0.152	0.181	1.56	1.62	2.43
v.s.w.r. = 1.67	40	0.203	0.036	0.176	0.278	0.108	0.123	0.156	1.32	1.37	1.99
	30	0.187	0.059	0.159	0.244	0.196	0.091	0.121	1.17	1.20	1.65
For Pi-input, read →		C1	C2	L2	C3	C4	L4	C5			



ELLIPTIC FILTERS
(Chebyshef-Cauer Filters)
TABLE 3.—POWER-MATCHED
5th Order (N = 5)
(Normalised to 1 Hz. at frequency where the skirt has dropped to the A_P value)
(Units: L Henrys, C Farads)

PI-INPUT
Valid for voltage source if ratio R_{load} to R_{source} is high, say 20 to 1.



Rip. Depth A_P Reflect. r% v.s.w.r.	Desired dB. Atten. at f_S	$\frac{f_S}{f_C}$	$\frac{f_4}{f_C}$	$\frac{f_2}{f_C}$	C1	C2	L2	C3	C4	L4	C5
A_P = 0.1 dB.	60	2.06	2.16	3.36	0.080	0.012	0.182	0.222	0.025	0.216	0.201
r = 15%	50	1.70	1.77	2.71	0.074	0.020	0.172	0.210	0.046	0.196	0.192
v.s.w.r. = 1.35	40	1.41	1.46	2.17	0.062	0.034	0.158	0.190	0.072	0.165	0.176
	30	1.22	1.25	1.77	0.046	0.059	0.136	0.163	0.130	0.124	0.157

ELLIPTIC FILTERS
TABLE 4.—VOLTAGE SOURCE
5th Order (N = 5)
(Normalised to 1 Hz. and 1 ohm load at frequency where the skirt has reached the A_P value of attenuation = 0.33 dB.)
(Units: L Henrys, C Farads)

$$C2 = \frac{0.200}{50 \times 30 \times 10^6} = \frac{0.2}{15 \times 10^2} = 0.000133\ \mu F. = 133\ pF.$$

$$C4 = \frac{0.166}{15 \times 10^2}\ \mu F. = 117\ pF.$$

$$\text{Frequency } f_s = 30 \times 1.7 = 51 \text{ MHz. is acceptable.}$$

This filter could be wound as air-cored coils of a few turns, but would need careful shielding. ●

BIBLIOGRAPHY

A. I. Zverev, Handbook of Filter Synthesis (1967), John Wiley & Sons (from which Tables 3 and 4 are reproduced by permission of the publishers).
B. Zeines, Introduction to Network Analysis, Chapt. 9, Prentice-Hall.
Louis Weinberg, Network Design by use of Modern Synthesis Techniques, Hughes Research Laboratories.
Dal Stivens, "The Gambling Ghost and Other Tales".

FOOTNOTE

The writer would be interested to hear from any reader who makes use of the material in this series of articles.

TECHNICAL REVIEW

By "A.R." Technical Assistants

"LEARNING THE MORSE CODE"

"During the past decade increasing difficulty has been experienced in obtaining adequate Morse training practice by those who, for reasons of their employment, or hobby, are obliged to hold Morse code qualifications. This situation has arisen largely because, in the general communication field, telegraphy gradually has been phased out in favour of telephony, since the latter is a faster and more convenient means of communication. As a direct result, those organisations which have been providing Morse training facilities found it unprofitable to continue because of the increasingly reduced demand for their services. Today, such services virtually have ceased to exist.

"However, a widespread requirement for Morse training facilities still exists—if not in the commercial communication field—then in other areas where the need for a code system still applies. In the aviation and marine fields, certain catagories of pilots and ship's officers, because of their navigation responsibilities, are required to hold Morse qualifications in order to recognise the code symbols transmitted by ground-installed navigation aids. Again, in the hobby field, Amateur Radio operators must pass a Morse test and even Boy Scouts and Girl Guides have Morse included in their training schedules."

The above two paragraphs are the introductory notes on the folder of "Learning The Morse Code" produced by Flight Training Centre (Aust.) Pty. Ltd. This course consists of one 7" LP and two 12" LP records which

are played on a normal record player at a speed of 33 r.p.m. to start with and later, as copying speed is increased, at 45 r.p.m. As would be expected, the tone is different on the two playing speeds, but is equally pleasant on both.

Mr. Ivan R. Hodder introduces the course on the records and uses the voice method of learning the code symbols. For instance, the letter "P" is sung (virtually) as "D'DAH DAH DIT". He does not use the audio oscillator until the symbols are known fairly well, and some practice has been obtained at putting these sung symbols down on paper. Once this has been achieved, he then changes over to the audio oscillator and this is used for the rest of the course. The two reviewers are equally divided on their opinion regarding the use of the voice method as the starting method of learning. It may help or hinder the ultimate speed of learning. The quality of the audio is quite good with little if any background noise to distract the student. Mr. Hodder speaks clearly and precisely so no misunderstanding of his meanings should occur. It would be desirable to have a record player with little wow or flutter and the use of headphones with the player will materially reduce the distracting effect of any room echoes.

The general packaging and write up on the back of the folder are good and help to make this course complete. It is a pity that the printed symbols miss out the more commonly used punctuation marks—even to the extent of the start and finish symbols. The last two are, however, used in the texts to indicate start and finish. Numerals receive scant use in this course and it is felt this is an unfortunate decision by Mr. Hodder, particularly if this course is to be used by aspiring Amateurs. As with any recorded method of code whereby the recording is played back a number of times to the student, familiarity with the text becomes a problem. To overcome this, it is suggested that the pickup head of the record player be placed at random on the record, so reducing temporarily the possibility of anticipating successive letters or numerals.

SUMMARY

This course is considered to be a good starting course for those people who have no access to skilled training. The instructions are clear, concise and adequate for the newcomer who wants to learn Morse code. The lack of adequate practice with numerals and the lack of punctuation signs are the only criticisms, and the worth of the course in other regards far outweighs these. This course, like any of this type, cannot in itself be consideraed a complete course. Once a person has become familiar with the contents of this course, he should then get practice on the air from one or more of the stations that send slow Morse for beginners. One such station is VK2BWI.

The course used in this evaluation was supplied through the kind courtesy of William Willis and Co., 77 Canterbury Road, Canterbury, Vic., 3126, from whence further details should be obtained. ●

USING "STANDARD ORBITS" FOR OSCAR 6

*BY RICHARD TONKIN**

● The standard Orbit-satellite tracing system has been successfully used by many amateurs to track OSCAR 6. Sets of Standard Orbits for the Australian State capitals were included as an insert in the October, 1972, issue of "A.R." The orbit achieved by Oscar 6 is extremely close to that used to produce Standard Orbits and no changes to the data published in last October's "A.R." are required.

At this stage, with the satellite operational and with many amateurs having either worked through the 2-10 metre repeater, or planning to do so, it is considered desirable again to run through the proper use of the Standard Orbit system.

The Standard Orbits system relies on the fact that the satellite is in an orbit very close to circular, at a height of approximately 1460 kilometres above the earth. Oscar 6 has, in fact, achieved just such an orbit. Each orbit around the earth is completed in 114.99 minutes which, for simplicity, we can round off to 115 minutes, or 1 hour, 55 minutes. The Equator is taken as a reference point on the orbit. Each orbit begins when the satellite crosses, travelling north, and ends 1 hour, 55 minutes later when the Equator is next crossed, again travelling north. This 1 hour, 55 minutes is the PERIOD of the orbit. From the time one orbit begins at the Equator, to the end of that orbit, 1 hour, 55 minutes (that is, one PERIOD) later, the Earth rotates westward, below the satellite by (in the case of OSCAR 6) 28.7 degrees, so that if, say, orbit number 547 begins on the Equator (travelling north) at 181.0 degrees west longitude at 0852 GMT, the next orbit (number 548) will begin on the Equator 1 hour, 55 minutes later and, during that time, the Earth will have rotated westward, beneath the satellite, by 28.7 degrees. Therefore, orbit 548 will begin at 10.47 GMT (08.52 plus 01.55), at 209.7 degrees west longitude (181.0 plus 28.7) —or 210 degrees west, to round off the figures. These figures of 10.47 GMT at 210 degrees west longitude are referred to as the ascending (i.e. travelling into the Northern Hemisphere) NODE (i.e., Equator crossing), for orbit 548

ASCENDING NODES are the key factors in the Standard Orbits system. The sets of Standard Orbits for the state capitals published as an insert in October, 1972, "A.R." are simply the azimuth and elevation bearings at two minute time intervals for typical orbits of the OSCAR 6 satellite which come into range of the state capitals and the districts around them. It will be seen that orbits are printed out with reference to ASCENDING NODES and are spaced at 5 degree intervals. Ideally of course it would be desirable to have the Standard Orbits at 1 degree intervals, but the marginally increased tracking accuracy that would be achieved would be far-outweighed by the fact that 5 times as many Standard Orbits would have to be printed. Hence a compromise of 5 degrees intervals was reached - this has been found to be quite satisfactory, even for use with directional antennas on 2 metres and 70 centimetres.

Returning now to the "ASCENDING NODES." If you are, for example, in or near Sydney and you want to track OSCAR 6 on a hypothetical orbit 548, what do you do? By looking at the Standard Orbit tables for Sydney, you will see that the ASCENDING NODE for orbit 548 (210 degrees west longitude) appears on the tables. If it had been 211 or 212 degrees the Standard Orbit for 210 degrees should still have been used, as it is the closest to 211 or 212. Having selected the Standard Orbit marked "ASCN NODE 210 W," what next? Simply add the number of minutes at the beginning of the "ADD MINS" column on the Standard Orbit table (92 minutes) to the ASCENDING NODE time (10.47 GMT) for orbit 548 —so, 10.47 GMT plus 92 minutes equals 12.19 GMT. That means, then, that the satellite will come into range of Sydney at 12.19 GMT at an azimuth bearing of 175 degrees (the azimuth reading corresponding to the 92 minutes at the start of the 210 degrees west Standard Orbit). By looking at the 210 degrees Standard Orbit, it can be seen that OSCAR 6 will reach maximum elevation above the horizon of 32 degrees at the 102 MINUTE mark (12.29 GMT), and that the satellite will go out of range on an azimuth bearing of 308 degrees at the 112 minute mark (12.39 GMT). Therefore the orbit will be within range of Sydney for a total of about 20 minutes.

It can be seen that the "ADD MINS" column in the Standard Orbit sets refers to the time that it takes the satellite to travel from the ASCENDING NODE to the point where it comes over the horizon at the appropriate city. So that in the example above, it takes OSCAR 6 92 minutes to travel from the Equator to a point where it comes into range of Sydney, on orbit 548, which is a night time orbit. On daytime orbits, it takes the satellite about one hour to come into range of Sydney, after crossing the Equator, travelling north. The half-hour difference between daytime and night-time orbits is caused by the fact that the satellite has to travel a shorter distance from the Equator to reach Sydney on the south-bound (daytime) orbits. Orbit 548, like all night-time orbits over Australia, travels from south-east to north-west, while the daytime orbit travels from north-east to south-east.

The morning (southbound) orbits of OSCAR 6 over Australia have ASCENDING NODES between 290 and 80 degrees west, while the evening (north-

(continued on Page 11)

* 13 Nestan Drive, Ringwood, Vic., 3134.

THE G5RV* By the Man Himself

● The G5RV aerial is a multi-band dipole specifically designed with dimensions which allow it to be installed in most normal-sized back gardens, permitting effective operation from 1.8 to 30 MHz.

As the G5RV aerial does not make use of traps or ferrite beads, the "dipole" portion becomes progressively longer in electrical length with increasing frequency. This effect confers certain advantages over a normal or trap dipole because, with increasing electrical length, the major lobes of the vertical radiation patterns tend to be lowered as the frequency is increased.

Thus, from 7 MHz. up, most of the energy radiated in the vertical plane is at an angle suitable for DX working. Furthermore, the horizontal polar diagram changes with increase of frequency from a more or less typical two horizontal dipole diagram to that of a typical "long wire" aerial at 14.21 and 23 MHz.

Although the impedance matching of a suitable (non-critical) length of 75 ohm twin feeder (preferred) or 75 to 80 ohm co-axial feeder from the base of the matching stub to the transmitter or preferably, to a suitable aerial tuning unit, is approximate only for most bands, a very good match indeed is obtained on 14 MHz. It so happens also that the polar diagram on this band is that of a three-half-wavelength long-wire which is particularly suitable for all-round DX working and gives an estimated gain of about 3 dB. over a simple dipole in the directions of the four major lobes.

The above reasoning does not apply to its use on 1.8 MHz. where it functions as a Marconi or T aerial with most of the effective radiation taking place from the vertical or near-vertical portions of the system, the "flat top" acting as a top-capacity loading element. However, with the transmitter end of the feeder strapped and with the system tuned to resonance with a suitable series inductance and capacitor circuit connected to a good earth, or a counterpoise, very effective radiation on this band is obtainable even when the flat top is as low as 25 feet above ground.

CONSTRUCTION

The dimensions of the aerial and matching stub are as shown in Fig. 1. It should be noted that it is quite in order to "bend" the lower half of the matching stub if desired owing to relatively low height above ground of the flat top. The writer has used this aerial for many years at a height of only 25 feet with excellent results on all bands from 1.8 to 28 MHz.

A word about the matching stub is in order. If this is of open wire feeder construction (preferred because of lower losses, especially at 21 and 28 MHz.) its length should be 34 feet (17 feet for the half-size version), but if 300 ohm ribbon is used allowance must be made for the velocity factor of this type of twin-lead. Since this is approximately 0.88, the actual physical length of the 300 ohm ribbon stub should be 29 feet 6 inches. It should be borne in mind that this matching stub is intended to resonate as a half-wave impedance transformer at 14 MHz., which was chosen as the design centre frequency for the G5RV aerial, thus giving a very good impedance match for a 75 to 100 ohm twin-lead or co-axial cable connected to the base of the stub.

If desired, due to lack of sufficient space to accommodate the 102 feet long flat top, the ends of the aerial may be dropped vertically (or semi-vertically) for up to 10 feet at each end, thus reducing the overall length to 82 feet.

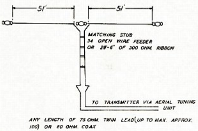


Fig. 1.—Dimensions of the full-size G5RV Aerial. For the half-size version, the dimensions of the flat-top and matching stub are scaled proportionately.

An alternative arrangement to that of the matching stub and twin-lead or co-axial cable feeder is to use an 83 feet length of open-wire feeder measured from the centre of the flat top to the terminals of the a.t.u. This arrangement permits parallel tuning of the a.t.u. on all bands from 3.5 to 28 MHz. with very low feeder losses.

The spacing of either the open-wire stub or the 83 ft. long open-wire feeder is not critical and may conveniently be anything from 2 to 6 inches, using either 14 or 16 s.w.g. copper wire. Although the use of 14 s.w.g. is recommended for the flat top, 16 s.w.g. is adequate for the matching stub or tuned feeder and is easier to "hang" neatly.

It is recommended that attention be paid to making a sound mechanical job of the construction of the aerial. In particular, if 300 ohm ribbon is used for the matching stub, the ribbon should be looped over the centre insulator of the flat top and secured with nylon thread or plastic tape, leaving "flying" ends about 9 inches long forming two loops for connection to each half of the aerial. This type of construction avoids breaking of the ribbon due to swinging and vibration in high winds. Alternatively, a suitable triangular shaped ceramic or plastic dipole centre insulator which is designed to secure the 300 ohm ribbon may be used.

Although it may be very convenient to use a length of, say, up to 100 ft. of co-ax. direct from the transmitter to the base of the matching stub, it must be remembered that such an arrangement will tend to produce currents which will flow in the outer conductor of the co-ax., causing unwanted radiation from the co-axial feeder. This may be avoided by the use of either 75 ohm twin-lead and a suitable a.t.u. or the open-wire feeder and a.t.u. as already mentioned. However, the use of a suitable wide-band balun as suggested in the article by G3HZP in July 1966 R.S.G.B. Bulletin would be preferable if co-axial cable is to be used.

Nevertheless, in practice very satisfactory operation can be achieved by the simple use of co-ax. direct from the transmitter to the base of the matching stub even though the v.s.w.r. may reach 10 to 1 or more on 3.5 MHz. This figure may be reduced to about 5 to 1 on 3.5 MHz. by "pruning" the co-ax. On the higher frequency bands the v.s.w.r. on the co-ax. lies between 5 to 1 and 1.5 to 1, the latter figure applying to 14 MHz. where, as explained above, the matching is very good.

Contrary to general belief, a v.s.w.r. of up to 5 to 1 on a length of co-ax. up to about 100 feet, at the frequencies considered here, results in negligible loss of power. However, this is not to say that it is not better to keep the v.s.w.r. figure as low as possible, especially where a low-pass t.v.i. filter is to be used. It is mainly for this reason that the writer prefers to use a convenient length of 80 ohm co-ax. from the transmitter to an a.t.u. and then 75 ohm twin-lead to the base of the stub. In this way, using a low-pass filter and a v.s.w.r. meter in the length of co-ax., a perfect, or near perfect, match can be obtained for the transmitter and filter on all bands.

THE AERIAL TUNING UNIT

As stated above, the writer prefers to use an a.t.u. for the reasons given. There are various satisfactory forms of a.t.u. but one which the writer has used for many years and which is extremely flexible electrically and yet does not require the coils to be tapped for optimum feeder loading, is shown in Fig. 2.

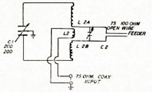


Fig. 2.—A suggested aerial tuning unit for use with the G5RV aerial. C1 is a 200/200 pF. split-stator transmitter capacitor, the plate spacing being determined by the power it will have to handle. The coupling capacitor C2 consists of three 500 pF. broadcast receiver variable capacitors connected in parallel. If necessary, this combination may be supplemented by a bank of switched high-voltage mica capacitors.

* Reprinted from "Ohm" Magazine.

In any case, whatever form of a.t.u. is used a suitable v.s.w.r. meter should be inserted in the co-ax. feeder from the transmitter output to the a.t.u. Optimum loading and maximum harmonic suppression will be achieved by watching the reverse current in the v.s.w.r. meter and adjusting both a.t.u. tuning and loading capacitors for minimum reverse current.

If the link-coupling coil is common for all bands (using plug-in a.t.u. coils) it is preferable that it be of the "swinging" type, i.e. adjustable coupling. It will be found that, starting with the link coil fully coupled, normally, after the a.t.u. tuning and loading capacitors have been adjusted to give the lowest possible reverse current, adjustment of the link-coil coupling will, in nearly all cases, permit a v.s.w.r. of virtually 1:1 to be obtained on the co-ax. cable to the transmitter.

However, if a.t.u. coils having individual link-coils are used, the number of turns on each link should be adjusted to suit the actual conditions applying to a particular installation for each of the bands.

For a common, swinging, link-coil three turns is about as good a compromise as may easily be obtained.

Table 1 gives coil winding details for each band.

Band (MHz.)	Turns	Turn Spacing (in.)	S.W.G.	Coil I.D. (in.)	Fixed Link Coil* (turns)
3.5	17 + 17	close wound	14	2.5 (former)	4 or 5
7	9 + 9	close wound	14	2.5 (former)	3
14	5 + 5	1/10	10	2.25 (self support.)	2
21, 28	4 + 4	1/2	10	1.75 (self support.)	1

TABLE 1.

* Alternatively, a common three-turn swinging link coil 1⅞ inch i.d., 14 s.w.g. close wound; centre portion of coil formers cut away suitably to permit entry of swinging link coil.

THEORY OF OPERATION

The general theory of operation has been explained in the introduction. The theory of operation on each band from 3.5 to 28 MHz. will now be given in turn.

3.5 MHz.—On this band, each half of the flat-top plus about 16 ft. of each leg of the stub forms a foreshortened or slightly folded-up dipole. The remainder of the stub acts as an unwanted but unavoidable reactance between the centre of the dipole and the feeder to the transmitter or a.t.u. The polar diagram, is similar to that of a horizontal dipole. See Fig. 3.

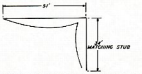


Fig. 3.—The current distribution of the G5RV aerial at 3.5 MHz. Only one half is shown. The aerial functions as a half-wave dipole partially folded up at the centre. Some reactive mismatch occurs at the base of the matching stub, but performance is very good despite a rather high v.s.w.r. on 75 ohm co-ax. or 75 ohm twin feeder to the transmitter or a.t.u.

7 MHz.—A similar arrangement exists at this frequency except that the flat top plus 16 ft. of the matching stub now functions as a partially folded-up "two half waves in phase" aerial, giving a polar diagram somewhat sharper than a conventional 1/2λ dipole and low angle vertical plane radiation. Again, the matching at the base of the stub is degraded somewhat by the unwanted reactance of the stub, but despite this the system loads well. See Fig. 4.

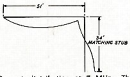


Fig. 4.—Current distribution at 7 MHz. The aerial now functions as two half-waves in phase (partially folded at centre). Some reactive mismatch still occurs at the base of the stub, but operation is very effective.

14 MHz.—At this frequency the conditions are ideal. The flat-top forms a three halfwave long-wire centre-fed aerial having six lobes of radiation, four major and two minor. As the centre impedance of a wire of this length at about 30 to 35 ft. above ground is approximately 90 to 100 ohms and the 34 ft. stub acts as a 1:1 impedance transformer, the match to an 80 or even 75 ohm feeder is quite acceptable. Most of the radiation in the vertical plane is at an angle of about 14 which is very effective for DX working. See Fig. 5.

21 MHz.—Here the aerial works as a five halfwave long-wire giving a very effective polar diagram and good low-angle radiation. Although a bad mismatch occurs at the base of the stub, the aerial loads well and performs very satisfactorily. See Fig. 6.

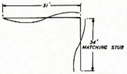


Fig. 5.—Current distribution at 14 MHz. In this case, the aerial functions as a 3/2 wavelength long wire. A centre impedance of about 90 ohms is transferred to the base of the matching stub (this acts as a 1:1 impedance transformer) and results in a good match to either 75 ohm co-ax. or 75 ohm twin feeder.

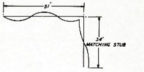


Fig. 6.—Current distribution at 21 MHz. The aerial functions as a 5/2 wavelength long wire. Mismatch at the base of the stub when coupled to 75 ohm co-ax. or 75 ohm twin feeder results in a high v.s.w.r., but operation remains effective.

28 MHz.—On this band the aerial functions as two 3/2λ long wires fed in phase. The polar diagram is similar to that of a typical 3/2λ long wire with slightly sharpened lobes and the radiation is at a low angle, good for DX working. Again, the mismatch at the base of the stub is considerable but, in practice, the aerial loads well and works very effectively. See Fig. 7.

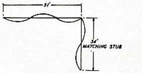


Fig. 7.—Current distribution at 28 MHz. The aerial is effectively two 3/2 wavelength long wires fed in phase. Mismatch to 75 ohm co-ax. or 75 ohm twin feeder at the base of the stub causes a high v.s.w.r., but operation is effective especially if an a.t.u. is used.

In connection with the above descriptions, reference should be made to the Amateur Radio Handbook or the A.R.R.L. or "CQ" Amateur Handbooks where the polar diagrams of typical long-wire aerials may be found.

THE HALF-SIZE VERSION

Many requests have been received for information on the half-size version of the G5RV aerial for use in very restricted space. It is quite possible to scale all wire length dimensions (including that of the stub) down to exactly half-size and the resulting aerial will work from 7 to 28 MHz. Optimum performance and impedance matching will occur on 28 MHz., where the operating conditions will be as for the full size version at 14 MHz. ●

FEDERAL W.I.A. NEW ADDRESS:
P.O. BOX 150,
TOORAK, VIC., 3142

Victorian Division address is unchanged as P.O. Box 36, East Melbourne, Vic., 3002.

THE HISTORICAL DEVELOPMENT OF U.H.F. CIRCUIT TECHNIQUES

PART ONE

ROGER LENNED HARRISON, VK9RI and VK2ZTB (ex VK3ZRY)*

● In these articles the author records, in chronological order, the efforts of the people and research organisations who made contributions to the development and use of the radio frequency spectrum between 30 MHz. and 60 GHz.

SUMMARY

I think it is significant that Hertz performed his now famous experiments in this region, but the region above 30 MHz. was mostly neglected until about 1920. In the following decade American Radio Amateurs began exploring the region just above 30 MHz. The techniques employed were crude and consisted of modulated oscillators and regenerative detectors. Results, however, were encouraging and frequency limits were gradually pushed back over the years up to W.W. II.

Also during those two decades preceding W.W. II. the idea of guided waves was stumbled upon by Otto Schriever and George Southworth. George Southworth first explored guided waves and later, with assistants, he developed many waveguide components.

The war years gave much impetus to u.h.f. techniques development and many devices such as reflex klystrons, improved magnetrons (first appeared 1936), travelling wave tubes and waveguide circuit elements appeared. During the decade immediately following the war, masers and more exotic travelling waves devices appeared.

In 1948 the transistor appeared as well as several other semiconductor devices.

The two decades following war saw many devices developed—both vacuum electronic and solid state devices. These devices provided an improvement in techniques for all regions throughout the spectrum between 30 MHz. and 60 GHz. Such devices as the carcinotron and the planitron, the travelling wave maser, the Alder tube, tunnel diodes and varactors caused small revolutions in u.h.f. circuit techniques in their particular fields of application.

Very recently **mesa construction** and **planar-epitaxial** transistors have been developed and are suitable for use in the u.h.f. bands up to the Giga Hertz region. These devices promise much for the future.

Overall, it appears that prior to the war basic circuit elements and fundamental ideas were developed. The war seemed to change this and active circuit devices were devised to overcome problems of generating power, low noise amplification, etc. The years following the war seemed to have carried on this developmental trend.

* P.O. Box 702, Darlinghurst, N.S.W., 2010.

INTRODUCTION

I will broadly classify the frequencies extending from 30 MHz. to 60 GHz. as u.h.f.

The lower limit I have set at 30 MHz. as this was considered the start of the u.h.f. region in the early part of this century. All frequencies above 30 MHz. were then regarded as in "the ultra-highs".

The upper limit I have placed at 60 GHz. as this appears to be the limit of modern practice. Experimental generation of frequencies has occurred beyond this, but exceedingly little information can be obtained—and then only as vague references to developmental experiments.

Throughout this article I will make use of the term Hertz to denote cycles per second as this is a concise and accurate way of expressing the fundamental unit of frequency. It is interesting to quote here from the introduction to "Ultra-High Frequency Techniques".[1]

". . . One is the use of Kc. and Mc. where kilocycles per second and megacycles per second are meant. Until some simpler name than cycles per second is adopted in the English-speaking countries, it is inevitable that kilocycles or Kc. and megacycles or Mc. will be used in oral transmission."

The concluding chapter ends at 1965 as this was written in 1967 and 1965 was the most convenient, if not the obvious, year to end the post-war development decades. I hope that the ensuing decade proves as fruitful as the previous one. Indeed, so far (1970) it appears to be more so!

1850-1900: MAXWELL'S THEORY AND HERTZ'S PROOF

Prior to 1859 a mathematician, James Clerk Maxwell, had made a study of the work done by Ohm, Kirchoff, Henry, Lenz, Coulomb and, particularly, Faraday. From the study of these, and several other people's works, he formulated his electromagnetic theory and published in 1859 the argument and the mathematics of his idea.

In this publication he made predictions as to the properties of electromagnetic waves. He predicted that electromagnetic waves had very similar properties to those possessed by light which had already been investigated. He also postulated that light was an electromagnetic wave.

This rather revolutionary idea caught the attention of several people, mainly physicists, who were investigating electrical phenomenon at the time. Among them were Lord Kelvin (Britain), Popoff (Russia) and the now famous Henriech Hertz from Germany.

During the years 1886 to 1888 Hertz conducted a series of experiments to investigate the main portions of Maxwell's theory. The results of these experiments indicated that Hertz had achieved an amazing degree of success in what he had set out to investigate.

The point that is of interest is that these experiments were conducted using equipment which generated frequencies in the region between 30 MHz. and 600 MHz.[2, 3] The equipment was simple but very effective; using lenses constructed of cast paraffin and reflectors made of copper, and a spark gap discharge (an oscillatory discharge), Hertz very ably demonstrated that electromagnetic waves had similar properties to light. These experiments were conducted near 500 MHz.[3] He measured the velocity as being 280 km./sec., which is very close to that of light. The velocity of propagation experiments were carried out at several frequencies from 30 MHz. to 150 MHz.[3]

These experiments were published in a number of papers in 1888 and 1889 and were followed by the book "Electric Waves" in 1894.[3]

These publications aroused the interest of two people who greatly advanced the knowledge and use of the idea postulated by Maxwell. One was a British scientist, Sir Oliver Lodge, and the other was an Italian engineer, Guglielmo Marconi.

1900-1920: THE ADVANCEMENT OF A NEW SCIENCE

Around 1890 Sir Oliver Lodge experimented with resonant circuits and aerial structures. But this work was done around frequencies of 100 kHz. to 500 kHz.

In 1894 Marconi began experimenting in his father's estate with "wireless" communications. The apparatus was crude and similar to that used by Hertz. It consisted of an induction coil and a Morse key with a sheet of metal for an antenna. The receiver had a similar antenna and he used a coherer for a detector, later improving this device.

Marconi filed his first patent in June 1896 in London. During the ensuing years he developed his equipment, establishing communications over both land and water using a combination of land stations and naval ships. In 1900 Marconi had developed his equipment into a practical form and patented his apparatus. This was the now famous patent No. 7777.[4]

Marconi drew heavily from the work and apparatus of Sir Oliver Lodge and the apparatus that Marconi developed and originally patented used similar frequencies, viz., in the range 100 to 500 kHz.

In America, Flemming recognised the possibility that the thermionic diode (invented by Edison) could be utilised for the detection of Radio signals, and in 1905 he patented a device for this purpose. This thermionic device was essentially that produced and investigated by Edison.[4]

This device provided a leap forward in the then primitive art of "wireless" communications, then mainly being investigated by Amateurs with home made equipment.

In 1907 an even larger step forward was taken by Lee de Forest when he patented the "triode" valve. This device provided amplification and paved the way for future development of circuit techniques.[4]

The first World War speeded the development of techniques somewhat, but still the frequencies involved were below 30 MHz. Much use of the spectrum below 1.5 MHz. was made by military and government authorities and Radio Amateurs were relegated to "below 200 metres" (above 1.5 MHz. at the cessation of hostilities).

This gave rise to an unexpected source of technical development and much private research and widespread application by Amateurs pushed high frequency circuit techniques toward 30 MHz.

Towards the end of this period two German physicists investigating the fundamental operation of thermionic vacuum tubes and various circuit techniques observed that certain tubes gave rise to oscillations independent of the external circuit and at an extremely high frequency.

The two men involved, Barkhausen and Kurz, were, at the time, investigating very high frequency oscillator circuits.

In 1920, they published a paper entitled "The Shortest Waves Producible by Means of Vacuum Tubes".[5,6]

Also in 1920, George Southworth, then a lecturer and student at Yale University in America, conducted a series of experiments aimed at accurately measuring the dielectric constant of water. His apparatus is shown in Fig. 1.

He set up Lecher lines that extended externally from a water trough and which were coupled to a u.h.f. oscillator. Here I quote his own words[6]:

> "Upon conducting the experiment, I did not find in water the nice orderly standing-wave pattern found in air but instead there was evidence of other wavelength components superimposed on those to be expected."

He first thought that these resonances were peculiar to water, but soon found that these waves were functions of the dimensions of the trough. He also found that when the Lecher wires were removed entirely that the extraneous resonances were supported by the trough alone, whether it had metal sides or not.

These extraneous resonance patterns have since been recognised as TE_{10} waves in a rectangular guide.

At the same time a lecturer at the University of Kiel in Germany, one Otto Schriever, published a paper in which he described a series of waves that could be supported on dielectric wires of circular cross-section. These waves were identified later as transverse magnetic waves in a circular guide.

During his years at Yale University, George Southworth, lecturing and doing graduate studies, performed quite a number of experiments with u.h.f. oscillators and circuit techniques. These techniques subsequently came into common use by Radio Amateurs in the period 1920-1930. Some of this early equipment is illustrated in Fig. 2.

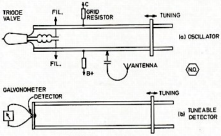


FIG. 2

In 1916 Marconi developed and tested some equipment which would enable the use of beams to be used to obtain greater privacy in communications. This had direct military applications which Marconi was desirous of demonstrating. The equipment operated on a wavelength of 3 metres (100 MHz.) and used cylindrical paraboloidal reflectors. With this equipment, good communications for ranges up to six miles was obtained. Further investigations were carried out by one of Marconi's employees, one C. S. Franklin, and in 1917 a range of 20 miles was obtained from Carnarvon in England. The wavelength used was again 3 metres and another improved, paraboloidal reflector was used.[7]

In 1919, Franklin successfully constructed oscillators using thermionic valves. His investigations, although done independently and without correspondence with Southworth in America, were very similar and used almost identical circuit techniques to those employed by G. C. Southworth.[17]

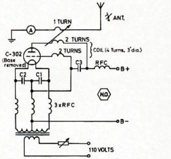
It appears that the period between 1900 and 1920 was a period of intensive investigation into a new science. The investigators proceeded, somewhat randomly, in many directions, several lines of which laid the foundations and fundamentals of u.h.f. circuit properties and techniques.

1920 TO 1930:
EXTENDING THE SPECTRUM

This was a decade during which Radio Amateurs played an important part. This was the period during which long distance propagation of short waves was studied.

The years between 1920 and 1925 produced a confusion of investigators and results into shortwave transmitters and propagation (below 30 MHz.). The circuit techniques used and spectacular results achieved by Amateurs during this period, sparked off a move towards ever decreasing wavelengths and the practical uses that might be obtained. It appears that Radio Amateurs were the first people to use frequencies above 30 MHz. for practical communications. The circuit techniques were refinements of those used at lower frequencies and subsequent developments employed circuit techniques similar to that used by Southworth earlier (see previous section).

In 1924 S. Kruse published an article in a magazine put out by the American Radio Relay League. The article was called "Working at 5 Metres". The article described a rather crude adaption of a Hartley oscillator, the circuit of which is shown in Fig. 3. The tube used was a baseless C-302 (a triode), then in fairly common use at lower frequencies. The frequency was changed by altering the spacing of the turns on the coil. A receiver used the same circuit except that two parallel metal discs were used as a variable capacitor connected between grid and plate.

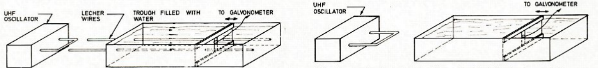


5 METRE OSCILLATOR FIG. 3

It appears that a number of people were using these techniques at about this time but the range of such apparatus was exceedingly limited and showed little hope of bettering the performance of equipment then being used below 30 MHz.

Frequency measuring equipment made use of Lecher wires which were later used as the frequency determining elements in oscillators. A rather

(Continued on Page 17)



(a) The standing wave pattern in the trough was not orderly and contained extraneous resonances

(b) Upon removing the lecher wires it was found that the trough supported a resonant pattern itself. This later sparked of the development of the waveguide.

SOUTHWORTH'S APPARATUS FIG. 1

CONSTRUCTING AN L.P. FILTER

A. G. EARWICKER,* VK3AOD

● Many of us have found rather irksome the "metal-bashing" aspects of housing a piece of home-brew equipment. The author has a simple solution, at least for low-pass filters.

No doubt many Amateurs like myself get satisfaction from building pieces of equipment, but feel disappointed somewhat in their final appearance because of our lack of skill or equipment to produce a suitable box or chassis worthy of our efforts. No matter what effort I put into the making of a box or chassis, it always falls short of that professional look.

Because of slight t.v.i. it was necessary for me to fit a low pass filter to my transmitter, but whatever book or magazine I read on the subject all their details of construction called for a three-division box, which to me and possibly many others meant constructional troubles.

* 67 Latrobe Street, Warragul, Vic., 3820.

Then I hit on an idea which proved to be very successful, not only to house a low pass filter, but over the years I could have saved myself a lot of constructional headaches had I thought of it before.

Briefly the idea is, why use a rectangular box anyway? Why not house the unit in a tube? All sizes are obtainable anywhere. If you are desperate and can't find the size you want, try the pantry or food cupboard, an empty food can might do the trick!

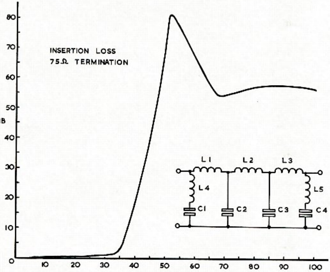
I can imagine all sorts of questions being asked. How are you going to fit and wire components in a can or tube? Much easier than on a chassis, is my reply.

This is the method. First of all arrange all the parts you wish to house as neatly as possible, then measure the overall length and diameter of the parts as arranged and from this calculate the length and size of the tube required. Now cut circular pieces of sheet metal (I used empty condensed milk cans because they are nicely tinned) that will snugly fit **into** the ends of the tube. You will require one for each end and one for each division.

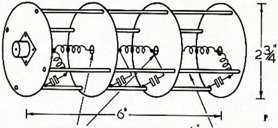
Now temporarily clamp or bolt these together and drill four ⅛" holes evenly spaced right on the edges. Cut four pieces of 8 or 10 gauge tinned copper wire or ⅛" brazing rod to the same length as the tube and thread the four pieces of sheet metal over the four pieces of wire. Now solder the two end pieces right on the ends of the wire and space and solder the divisions as required.

This is a surprisingly easy process if you used tinned copper wire. You will now find that you have a very sturdy little unit which is very easy to wire up and assemble. When this is complete, simply slip into the tube. It should not require any other fixing if a snug fit, and it can be easily slipped out again for service if required.

[Editor's Note.—To illustrate the technique the author supplied us with his actual filter unit. Dimensions and component values are shown in the accompanying drawings and table. Some doubts were felt about the effectiveness of the relatively loose discs inside the tube in preventing r.f. leakage from end to end, so attenuation measurements were made, yielding the results shown in the graph. The filter is obviously quite successful, particularly for t.v.i. on Channels 0 or 1. However, it might be improved still more at higher frequencies by the use of springy "fingers" around the disc edges to provide more positive contact to the inside surface of the tube.] ●



C1, C4—33 pF. 1200 v.w.
C2, C3—120 pF. 1200 v.w.
L1, L3—10 turns.
L2—11 turns.
L4, L5—7 turns.
Coils are ½ inch i.d., 8 t.p.i. 18 s.w.g. wire.



POLYTHENE INSULATING BUSH ⅛" BRONZE ROD
DIAMETER OF DISCS = INTERNAL DIAMETER OF COPPER TUBE CASING

USING "STANDARD ORBITS" FOR OSCAR 6

(continued from Page 6)

bound) orbits have ASCENDING NODES between 150 and 275 degrees west. As a guide, the morning orbits have similar numbers at the start of the "ADD MINS" column (between 56 and 82 minutes) than the evening orbits (between 86 and 104 minutes).

The orbit track of OSCAR 6 over Australia is approximately every two days so that, if the ASCENDING NODE for orbit 523 on 26th November were to be 211 degrees at 10.52 GMT, the ASCENDING NODE for orbit 548 will be 210 degrees at 10.45 GMT, on 28th November.

ASCENDING NODES data is available from the OSCAR State Co-ordinators, whose names and addresses appear below:—

Alan Hennessy, VK2RX, 23A New Illawarra Road, Bexley North, N.S.W., 2207.

John Nott, VK3ZQN, 28 Harley St., Dingley, Vic., 3172.

Lawrie Blagborough, VK4ZGL, 54 Bishop Street, ST. LUCIA, Qld., 4067.

Gary Herden, VK5ZK, 52 Arthur Street, Plympton Park. S.A. 5038.

Don Graham, VK6HK, 42 Purdom Street, Wembley Downs, W.A. 6019.

Peter Frith, VK7PF, 181 Punchbowl Road, Launceston, Tasmania, 7250. ●

NEWCOMER'S NOTEBOOK

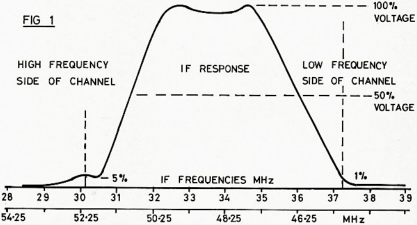
With Rodney Champness,* VK3UG

TVI ON 6 METRES

Have you ever wondered why your 6 metre transmission gets into your neighbor's television set when it is tuned to Channel 0? Overload, crossmodulation, grid rectification, &c., &c. Have you ever looked at the alignment curve of a typical TV set? Well, if you haven't, have a look at Figure 1.

The older TV sets will likely have a better IF selectivity curve. The reason for this being that up to four video IF stages were used, with their attendant coils, and adjacent channel sound and picture traps. The newer sets have as few as two video IF stages and usually no adjacent channel sound or picture traps — although for some these are available at a price. It can be seen by comparing the IF selectivity curves of a two-stage IF Figure 2, with no adjacent channel traps and a four-stage IF, Figure 3, with adjacent channel traps that you will more easily interfere with the former. It is a pity that the IF selectivity of many TV sets has been so degraded in recent years. This appears to be in an effort to cut costs, and as a result it leaves the sets wide open to interference from a variety of sources. You will find sets of different manufacture and/or different models are susceptible to interference to varying degrees.

FIG 1



OVERALL T.V. SET RESPONSE WHEN TUNED TO CHANNEL "O"

30.5 MHz is the sound IF frequency of 50 per cent. of TV sets as is 36 MHz the video IF frequency, exactly 5.5 MHz apart. By looking at Figure 1 you can see that the TV set has little if any response outside the TV channel. Hang on—wait a minute, if this is so how do I cause the interference? Look again at Figure 1, it will become obvious that this is a voltage versus frequency graph. If 100 per cent. response is shown as Odb and if the plotting of response is done in a decibels versus frequency graph the response pattern shown is vastly different as shown in Figure 2.

It can be seen that the TV set IF has considerable response outside the 7 MHz channel width, particularly on the Video side of the IF strip. The penny may be starting to drop as to what I am getting at. I've been quoting that the sound IF is on the low side of the IF strip when it is common knowledge that the sound carrier is on the high side of the channel. Now take Channel 0 and I'll show how the inversion occurs.

Channel 0	
Local Oscillator	
82.25 MHz	82.25 MHz
Carrier Picture	
46.25 MHz Carrier	Sound 51.75 MHz
Difference (IF)	
36.00 MHz	30.50 MHz

It can be seen that sideband inversion occurs, just as it does in all superhet receivers if the local oscillator is higher in frequency than the received signal. If you require no inversion of sidebands, &c., the local oscillator should be on the low side of the signal.

Turning once again to Figure 2, it can be seen that the TV's response to your signal at 52.001 MHz is only perhaps 20dB down on the response at mid-channel. The skirt selectivity of a good SSB receiver filter should be at least 100db down for a minimum of interference from adjacent stations.

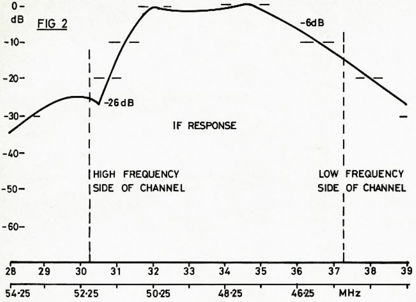
You will not need to think very long to realise your signal will easily exceed the input level of the television station even to the extent of being 20 dB stronger if you're close. There is certainly a lot of difference between a recommended rejection out of pass band of 100dB and the TV set's 20dB. This means that your signal at the video detector is as strong if not stronger than the desired TV programme, therefore, exit TV picture and sound.

Servicemen in general will not touch the IF alignment of a TV set even when it is obvious this should be attended to. Spot alignment techniques are usually quite satisfactory on the majority of sets. It is simple, quick and doesn't require elaborate equipment. Sets with their alignment out are also more susceptible to interference, as well as giving the owner a poorer grade of picture. Another common problem is encountered when the TV fine tuner is maladjusted — which is most of the time. This maladjustment can swing a fair proportion of the IF response into the amateur band, or in other cases into the two-way radio bands, or paging systems. This depends on which channel is being viewed. The performance on the TV channel is inferior and the interfering signal can be dominant.

To overcome the problem of maladjustment of the fine tuner is it not easily possible to arrange an Automatic Frequency Control circuit to control the tuner local oscillator? Varicap diodes suitable for the job are available. A discriminator tuned to the video or audio signal carriers in the IF strip could supply the control signal for the varicap diode on the local oscillator in the tuner. With such a circuit, it would be possible to do away with one more control—the fine tuning control. A control that is misused by the average viewer. This would eliminate one more cause of extreme TVI and give the viewer a better picture.

Now consider moving your transmission to 53.25 MHz. If you and your neighbours have accurately tuned sets with adjacent channel traps you may not cause TVI, as you should be spot on the adjacent channel picture trap, which should attenuate the TV set response by 60dB, as indicated by Figure 3. If the TV signal is, say, 1 mv into the set, the amateur signal would need to be of the order of 1 volt to be equal in strength at the video detector. Some sources indicate that for zero effect on the video the interfering signal should not exceed a hundredth of the wanted signal. This would mean that in the case just quoted the set would show absolutely no interference if the amateur signal were 10 mV into the set (provided no crossmodulation can occur in stages preceding the adjacent picture trap. —Tech. Ed.).

*44 Rathmullen Rd., Boronia, 3155, Vic.



OVERALL T.V. SET RESPONSE WHEN TUNED TO CHANNEL "O"

Perhaps I can now give some rough approximations on how little or how much effect your transmissions would have on this rather ideal set of Figure 3. Assume that the TV Channel 0 is putting out 100,000 watts effective radiated power. Assume that you are putting out 100 watts into a 10 dB gain aerial; in other words 1000 watts effective radiated power in the favoured direction. At the TV set your 1000 watts ERP can appear as a signal of 100 times (20dB) the signal of the TV signal and cause no trouble. Let's calculate very approximately how far away your neighbour would need to be and still not receive any interference.

The relative power of the TV transmitter is 50dB (100,000) above 1 watt. The amateur transmitter is 30dB (7000) above 1 watt . The previous statements indicating the trap attenuation 60dB and the relative level of the interfering signal permissible of 40 dB gives us a figure of 20 dB. This 20 dB is the amount the amateur signal can be stronger than the TV signal and cause no visible interference. This 20dB must be subtracted from the 30dB to give the effectivenes of each transmitter. The effectiveness of the amateur transmitter is therefore 10dB above 1 watt. 50dB minus 10dB gives a figure of 40dB in favor of the television station signal. The difference in the effectiveness of the two signals from the same site is 10,000 times or 40dB. This reduces when the amateur station is closer to the TV set than the TV station. Using the assumption that the signal power falls as the square of the distance it can be seen that the distance for a given signal strength varies with the square root of the power ratio. The square root of 10,000 is 100. This should mean that at say 50 miles from the TV station, no neighbour further than half a mile away should notice any TVI, with your aerial beaming directly into the front of his. Consider if you are using 1 watt into a 10dB gain aerial, this distance reduces to 88 yards. Now, if you use the opposite polarisation you should gain up to another 20dB of attenuation. This could mean that you might work as close as 26½ feet, and no TVI. If you were to beam into the side of his aerial where he should have a null, the theoretical attenuation figures will indicate that you could work as close as two and a half feet and still cause no TVI. This is now assuming that there are no reflections off any other metal work nearby.

I have obviously talked you into the fact that TVI doesn't exist, or more truly that it shouldn't occur, if everything is okay. I was talking of a good quality set, in good condition, correctly set up in all regards (no wound down Channel 1 tuner biscuits, please), with a good aerial designed for Channel 0 and a properly balanced feeder. The average cut-price TV set has no adjacent channel traps, is roughly aligned, the viewer mistunes the fine tuner, the aerial has seen better days (rusty and with semi-conductor joints), and the feeder cable is open on one side. No wonder you cause TVI. See Figure 2 and compare it with Figure 3. It would make you weep.

As amateurs, I believe we must assume that the average TV set is far from perfect in its ability to reject out-of-channel signals. From observation of Figure 2 it can be seen that the further you take your transmission away from Channel 0 the less the TV set will respond to your signals. I believe this points very forcibly to one slavish habit that has become ingrown amongst many VHF operators. This habit is operating from the bottom end of the band upwards. In this case 52 megs upwards. For local work, where dependence on frequency selective propagation phenomena is not necessary, working from 54 MHz downwards would be sensible. Use your head and use the band for minimum interference. This could mean that you can operate 6 metres and your neighbour watch his TV with no trouble or strained relationships. It might be a wise thought in VK3 and VK4 to adopt one or other of the VK2 AM net frequencies, as I believe these are quite close to 54 megs. Shifting of FM nets would be desirable, too.

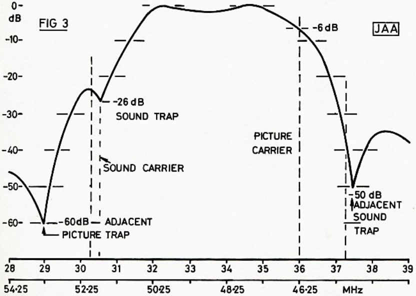
These same thoughts expressed above also apply equally well to those amateurs in Channel 5A area who work 2 metres, and to those who live in Channel 1 areas. Those who live in Channel 1 areas should work the low end of 6 metres.

Tests I have conducted indicate that (1) bandedge (52meg) operation causes considerable interference; (2) AM causes more trouble than SSB; (3) needless high power causes more trouble. A point of interest — I have run 10 watts output on 53.032 MHz and not caused TVI in my own set 50 feet away. The signal strength at the location tested was in the vicinity of 300uv. To overcome the interference I fitted an elementary trap on the receiver aerial terminals.

Having considered all the points I have brought up, other points should become obvious. How about traps fitted to the aerial terminals of the TV set, &c. This can be the subject of a future article. I would most definitely appreciate the thoughts of those who have tackled this problem with traps and other suppression devices. I would like to know how effective various ones are and any other data, constructional and otherwise, you can help with. Amateur radio has been accused of becoming an unproductive hobby, we are followers and imitators mostly, and not innovators. The suppression of interference to electronic equipment caused by transmitting equipment is one of the real challenges left to amateur radio in this day and age. Are you willing to take up this challenge, and help? If so, write to me with your information, or submit it independently.

This has probably been pretty heavy going under the title of "Newcomer's Notebook". If you have a bit of trouble getting the gist of it all the first time through I'll not be surprised.

Has your SW set got a BFO ? If it hasn't the BFO kit advertised in "Amateur Radio" by the YRCS is apparently very good. More about BFOs, &c., in a future article. ●



OVERALL T.V. SET RESPONSE WHEN TUNED TO CHANNEL "O"

AMATEUR FREQUENCIES:
ONLY THE STRONG GO ON — SO SHOULD A LOT MORE AMATEURS!

Commercial Kinks

With Ron Fisher,* VK3OM

This month I have compiled an interesting assortment of ideas for owners of the Trio TS510 transceiver, the Trio 9R 59DE/s receivers, and a few more hints for the FT200.

Firstly, my thanks to Bernard Taylor VK2AZY for his notes on the inclusion of a Yaesu noise blanker into his Trio TS510 transceiver. These units are available from Bail Electronic Services at a cost of 25 dollars each. Now for the step-by-step details on their installation.

A NOISE BLANKER FOR THE TRIO TS510.

Remove R316 10K ohms and take out the link between "P" and "TP 1" on the printed circuit board UC 1204J. Mount the noise blanker on top of the chassis over the edge of the same board and directly behind the VFO. Connect the 150 volt terminal of the blanker to "TP 2", the L308 side of R319 1K ohms, and the supplied dropping resistor to the 150 volt terminal on the board. These can be soldered to the terminal above the board.

If no CW filter is fitted the input and output leads can be run through the holes provided in the printed circuit board. The input lead connects to "TP 1" directly and the output lead connects to "P" via the 2pf. condenser mounted on a tag strip near L308.

The switch can be conveniently mounted in the blank "ext" switch position or alternately a pull-on switch could be provided for the RIT control, giving front-panel control.

The Yaesu noise blanker comes prealigned for the IF frequency of 3280 khz. as used in the FT 570/401 series transceivers, so slight retuning is needed. The crystal calibrator and the S-meter proved ideal for this. However, tuning the noise amplifier was more difficult (T354). A noise source is needed to peak this, and Bernard finished up running his antenna lead to the ignition system of his car, then aligning with a digital VTVM reading millivolts AC.

With the Blanker in circuit (switch closed) blanking is adjusted to about 3db loss on the S-meter or as necessary. Bernard also notes that when he first installed the noise blanker, he placed it under the chassis but had problems with cross modulation and excessive band width on strong signals. Mounting the unit on top of the chassis as described overcomes the trouble. Mr. Fred Bail, of Bail Electronic Services, tells me that Yaesu are producing a new type blanker which overcomes all problems with cross modulation, but which does not have such effective blanking action. Apparently cross modulation is a much greater problem in Japan than it is here, as no trouble has been noted locally in this connection. Consequently, Bail's are still importing the older, more effective units.

In conclusion, Bernard states that it is not necessary to retune L308 as the 2pf. condenser has little effect. To take the blanker out of circuit just lift the input and output leads and replace the jumper wire between TP 1 and P.

After noting the excellent results that Bernard Taylor has achieved in this modification, it seems likely that similar results could be obtained by installing one of the Yaesu blankers in the Heath transceivers. The Heathkit models SB100, SB101, SB102, HW100 and HW101 transceivers as well as the SB300 and SB301 receivers all use the same IF frequencies as the Trio TS510. One day when time permits I might give this a try in my SB101, but in the meantime if anyone tries it I would like to hear about it.

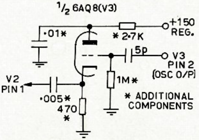
While on the subject of noise blankers, I hope to have details on a simple blanker for the FT200 in the next few months and I know quite a few people are waiting for this.

TRIO 9R 59DE/S. The Trio instruction book states that a cathode follower after the front end (HF) oscillator might be worth while. A letter from Alex Graham VK6ZCR contains details of the cathode follower he built. The circuit is reproduced here.

Alex reports a considerable improvement in overall stablility. I have also had a chance to try this out on my own receiver. The frequency pulling I reported some months ago, after I had increased the AGC action is practically eliminated by the inclusion of the follower and even shorting the output of the follower to earth has very little effect on the oscillator frequency.

If after completing all the previous modifications to the oscillator section you are still not happy with stability, there is one final modification that might be worth trying. This is to build a complete external oscillator section. There are quite a few benefits from this. Firstly, it might only be necessary to build a single band oscillator to cover the twenty-metre band for instance. Note that I have not actually tried this, but if you are keen enough, you might like to. Even a stable signal generator might be worth using. Don't forget to disable the normal oscillator.

With that I bring to a conclusion this series on the 9R 59DE receivers. If and when more modifications or data become available the subject could, of course, be reopened. In the meantime I think we have covered the subject rather well.



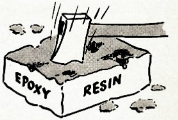
THE FT200 PART FIVE.—From John VK3AUJ comes the following hint. If you are inclined to use VOX and find that you run your anti-trip level full on, the distortion in the receiver will probably be of the order of 20 per cent. This is caused by the anti-trip rectifier being connected directly across the primary of the audio output transformer. To adjust the anti-trip tune the receiver for about a one KHz beat against the calibrator. If the anti-trip is set too high you will be able to hear the second harmonic audio beat quite clearly. Set the anti-trip just below the point where the second harmonic disappears.

Another VOX problem that came to my notice recently is where the VOX relay will pull in but will not release. Firstly check the diodes as mentioned in the FT200 Part Two (September), and also check resistor R11, 22K ohms 2 watt. In my case the resistor had gone completely open. The PTT mode was still OK but VOX was quite impossible. You will find that it is necessary to lift one end of this resistor from the circuit to test it.

Next month I will have information on changing Heathkit single-band transceivers to other bands, plus more of general interest. ●

* 3 Fairview Ave., Glen Waverley, Vic., 3150.

1973 SUBSCRIPTIONS NOW DUE PLEASE REMIT TO W.I.A., P.O. BOX 150, TOORAK, VIC., 3142.



PROJECT AUSTRALIS

With George Long,* VK3YDB

Oscar 6 has now been in orbit round the earth for three months and it is believed that a report on the activities should now be published. It should be noted at this stage that because of the early closing date for the January copy of "A.R." this article was written in the middle of November. Some of the comments in this article may therefore be out of date by the time of publication.

Oscar 6 is the first Amateur Radio Satellite designed for a long life. If all goes well, Oscar 6 may still be operational by January of 1974. This would indeed be a fine achievement for all Radio Amateurs round the world. It could also be worth while to remember that if all goes according to plan Oscar 7 might also be in orbit by that time.

Let us return in time and think about Oscar 6, which is presently with us. Firstly, let me go over some of the technical background. Oscar 6 has the following characteristics:

Input frequency: 145.900 to 146.000 MHz.
Output frequency: 29.450 to 29.550 MHz.
U.h.f. beacon output frequency: 435.100 MHz.
H.f. beacon output frequency: 29.450 MHz.

These are the essential specifications. The other thing to bear in mind is that Oscar 6 has an in-built a.g.c. system and that it will tend to attenuate any excessively strong input signals. Because the a.g.c. is not selective, the attenuation will apply to all signals regardless of their strengths into the satellite. Be warned therefore, the strong may spoil it for the weaker stations. The maximum power required for Oscar for successful communication is not in excess of 150 watts **e.r.p.** Note that this e.r.p. is not transmitter output. Hence fifteen watts into a 10 dB. aerial pointed at the satellite is all that is required.

The following problems have been noted with Oscar 6:

(a) The h.f. beacon on 29.450 MHz. is very weak and is rarely readable without a really good receiver and, at least, a beam. This is very unfortunate as it makes the telemetry difficult to obtain on this frequency and does not allow for ready acquisition of the satellite. The cause of the weak signals has not been ascertained with certainty, but is believed to be caused by incorrect adjustments prior to launch.

(b) The satellite tends to switch off during, before or after passes, but again the cause of this has not been firmly established, but may be due to pulses appearing on the h.t. bus as the solar cell currents change.

This fault may also cause the satellite to switch on without any ground command but this has not as yet occurred. Unfortunately, this has left the Australis Group with a problem because it requires that persons be available for all orbits. This is not always possible and leads to the satellite being off on some passes. So please bear with us, if the satellite is off when you expect it to be on, then please don't growl; we are doing our best but we have our daily bread to earn.

(c) Possibly a more serious problem is that the satellite is not, perhaps, receiving full charge from the solar cells, caused by an intermittent failure of the Z face solar panel. This is a small panel but the problem could become more serious as the cells deteriorate. This might mean that the time required for re-charging will be longer. The Australis Oscar Group will make every attempt to see that the Oscar 6 satellite is on every week-end when it is possible to have safe operation of the satellite and every effort will be made to keep all interested people informed about what is going on.

It is now possible to give more precise details of the equipment being used to get into Oscar 6. Firstly, on the transmitting side, it has been found that the two best modes are s.s.b. and c.w. S.s.b. seems to be marginally better than c.w. because more can be communicated in a shorter time than is possible with 10 w.p.m. Morse code. As stated previously, it seems that the low-powered s.s.b. stations have as much chance of operating via the "bird" as any high-powered station. One of the best signals into Oscar 6 at the beginning was using 50 watts into a dipole (VK1ZT). This will give you an idea how little power is required.

As for aerials, it seems that two varieties are preferred. Firstly, the old standby—the turnstile performs an excellent job when the satellite is about 10 degrees above the horizon. Below this the ten element (or less, depending on transmitter output power) is found to work very well. We have received reports that at low angles a vertical aerial is better, but this is unconfirmed. Have you any comments?

Bob VK3AOT has done very well using a.m. He is the only one I know who has done well using this mode and the Group would like to hear from anybody else who has used a.m., either with or without success.

On the receiving side, a good receiver is essential. It has been found that a barefoot commercial transceiver does leave something to be desired, but an appropriate 10 metre pre-amplifier (using an MPF121 or similar) will make all the difference.

Many types of aerials have been used with various results, but two easily constructed ones prove to be very successful. A groundplane is quite good when the satellite is not more than 30 degrees above the horizon. The other very useful aerial is the crossed dipole (a scaled-up 2 metre turnstile) but this is not the most effective if the satellite is on a low elevation pass.

The most successful system seems to be a combination of a crossed dipole and a groundplane with the ability to switch between the two. This is very important so that the best one may be selected quickly.

EXTRACTS FROM AMSAT 1972 ANNUAL REPORT

Amsat, the Radio Amateur Satellite Corporation, is a non-profit organisation founded in 1969 to develop amateur satellites and satellite experiments for the Amateur Service. Amsat's activities are conducted primarily through its members, under the guidance and co-ordination of an elected seven-member Board of Directors, and officers elected by the Board. Membership is international, and there are currently over 640 members and 52 member societies in 36 countries, representing a growth in membership of 50 per cent. in the last year.

Accomplishments for the Year 1972.—In January, the Amsat Board of Directors approved the construction of a new amateur communications satellite on a "crash" basis, to be ready in time for a launch with the ITOS-D meteorological satellite in the latter part of 1972. This satellite, Amsat-Oscar-C (A-O-C) was to be based on the use of the W5CAY Morse code telemetry and Codestore message storage systems, the W.I.A.-Project Australis command system, and the Amsat two-to-ten metre linear repeater, all of which had been constructed for the more complex Amsat-Oscar-B (A-O-B) multiple repeater satellite. The decision to develop A-O-C provided more time to complete and test the additional systems planned for A-O-B.

Amsat-Oscar-C is now familiar to all of us as Oscar 6—the first of a series of long life-time amateur satellites designed for a period of operation of a year or more in space. Its 910-mile altitude sun-synchronous orbit makes tracking fairly simple, since the satellite passes repeat at similar times on a two-day cycle.

Oscar 6 represents several innovations in space. This is the first time that satellite telemetry has been transmitted to the ground directly as Morse code. It is the first time a digital memory system, Codestore, has been used for the store-and-forward of Morse code and teletype communications/operations messages. A two-to-ten metre linear repeater designed for multi-channel communications is in operation from space for the first time, and also for the first time a beacon is operating in the new 435-438 MHz. portion of the 70-centimetre band allocated to the Amateur Satellite Service at the 1971 I.T.U. Space Conference. Oscar 6 also contains a 21-function command system capable of changing the operating conditions of the spacecraft by ground control.

In June, an Amateur Satellite Service Committee was established comprised of representatives of A.R.R.L., Project Oscar and Amsat. Chaired by W. W. Eitel, WA7LRU/W6UF, Chairman of the Board of Project Oscar, the committee will develop plans for funding and staffing satellite projects, advise on regulatory matters affecting the Amateur Satellite Service, and organise programmes for the public service use of amateur satellites.

In 1971, Amsat submitted a proposal to provide a ten-metre amateur station to fly aboard Skylab-A. N.A.S.A.'s manned orbiting laboratory scheduled for launch in 1973. The project, named Skylarc (for Skylab Amateur Radio Communications) was designed to encourage the use of space techniques by amateurs throughout the world, while providing the opportunity to communicate directly with astronauts during their leisure time. On January 7, 1972, N.A.S.A. sent Amsat a letter rejecting the proposal. The letter, in part, said: "It is with real regret that I must inform you that, in spite of the broad appeal of your concept and a generally favourable disposition to encourage Amsat activities, N.A.S.A. has concluded that we cannot add it to Skylab at this stage of the programme, and therefore, we must reject your proposal."

Amsat has also proposed to N.A.S.A. an amateur repeater experiment for launch as part of the ATS-G Applications Technology Satellite now planned for launch around 1976. This experiment, Syncart (Synchronous Amateur Radio Transponder) was proposed as a 146-to-435 MHz. 20-watt linear translator to be integrated into the ATS-G spacecraft for flight into synchronous orbit at a stationary position over the equator. While no final action has been received with regard to this proposal, present indications are that difficulties in implementing a suitable antenna feed system on ATS-G may cause N.A.S.A. to turn down the Syncart proposal.

Current Activity.—With the successful launch of A-O-C/Oscar 6 on October 15, Amsat activities are currently concentrated on assuring the most effective and efficient use of the satellite. Control stations have been established on the East and West Coasts of the United States, Eastern and Western Australia, and New Zealand, with an additional station planned in Europe. Codestore loading stations are also being set up in various parts of the world.

In conjunction with Oscar's operation in space, a contract has been awarded to the Talcott Mountain Science Centre to prepare a workbook containing curricula based on the use of amateur satellites as tools in the classroom. This workbook is expected to be completed shortly for distribution to schools throughout the world. In addition, several fellowships are being offered to educators outside the United States to spend a school term at the Talcott Mountain Science Centre to learn how amateur satellites can be used in classroom instruction. Upon their return home, these persons will use this experience to teach students in their own countries the various aspects of space science using Oscar 6 and future amateur satellites.

Also in the planning stages are experiments to use amateur terminals aboard small airplanes and boats for communications through Oscar 6. The successful two-way transmission of slow-scan television pictures has already been documented, and medical data exchange is also planned via Oscar 6.

Concurrently with the operation of Oscar 6, construction of Amsat-Oscar-B is continuing. During the past year Amsat has employed two aerospace technicians who were instrumental in completing Oscar 6 in time for its October launch. These technicians are now working on the A-O-B project constructing additional Morse code telemetry encoders, Codestore units, two-to-ten metre repeaters, and other systems needed for A-O-B. Amsat is expecting the delivery of the DJ4ZC/DJ5KQ Euro-Oscar repeater flight unit, which is now completed. This linear repeater has an uplink from 432.125 to 432.175 MHz., a downlink from 145.975 to 145.925 MHz. (inverted passband), and an output of 10 to 14 watts p.e.p.

Future Activity.—Looking ahead to this next year, Amsat will be most heavily involved in maintaining operation of Oscar 6 in efforts to maximise its usefulness and its operating lifetime. Concurrently, construction of Amsat-Oscar-B will continue at a rapid pace, with the hope of its launch soon after the end of life of Oscar 6. Because of this high level of activity, Amsat is in urgent need of volunteers to assist in the development of satellite hardware, and administrative and financial help is also needed if these projects are to be successful.

AMSAT COMMENT

"Amateurs 5000 miles apart should be able to communicate through Oscar 6 . . . K2RTH of New York was able to hear his own signals through the satellite when it was over Dakar in West Africa, over 3,000 miles away."

AMENDMENTS TO A-O-C TELEMETRY DATA

See Table on Page 11 of "A.R.," November, 1972.

(a) Channel 1A—
Parameter Range: 80.
Channel 6B—
Parameter Calibration: not meaningful.

(b) Amendments to final column (Final Calibration Data/Comments)—
1B: 1 plus x equals minus 1.078 N plus 105.8 (mA.).
1C: 1 minus x equals minus 1.102 N plus 107.2 (mA.).
1D: 1 plus y equals minus 2.240 N plus 219.0 (mA.).
2A: 1 minus y equals minus 2.105 N plus 205.5 (mA.).
2B: 1 plus z equals minus 4.300 N plus 417.0 (mA.).
2C: 1 minus z equals minus 4.100 N plus 402.5 (mA.).

(c) No other amendments are required.

CONTESTS

With Peter Brown,* VK4PJ

VK-ZL CONTEST, 1972

This contest seemed to go along okay although here I hardly made a contact with Ws and Ks when I was on the phone section of 20 metres. South America was open on Sunday afternoon, but not enough there. Japanese stations swamped 15 metres as far as I was concerned and as usual at times could be contacted several a minute.

I looked for Gs on 10 and 15 metres without much success, but George VK4XY told me that there was quite some 10 metre activity with G land after the VK-ZL finished.

When I listened the c.w. section was too much for me, but I don't know how long that activity continued.

I was very disappointed with 80 metres—only making one ZL contact. Where were they?

YJ8BL and VR1AA were in terrific demand and must have amassed a terrific score. It is very good to have high scorers to set a standard or goal if you wish and I hope that they can be with us next year.

CONTEST DATES

Ross Hull: On now, 1401 GMT, 4th December, 1972, to 1400 hrs. GMT, 21st January, 1973.

John Moyle National Field Day, 0600 GMT, 10th February, 1973, to 0800 GMT, 11 the February, 1973. The second week-end in February.

Remembrance Day 1973: August, get that c.w. operational, not much time. ●

* Federal Control Manager, Box 638, G.P.O., Brisbane, Queensland, 4001.

1973 CQ WW 160 METRE CONTEST

Mr. P. Nesbit, VK3APN, writes:—

STARTS: 0000 GMT, Saturday, January 27.

ENDS: 1500 GMT, Sunday, January 28.

1. This is a CW contest. No CW to phone or cross band contacts allowed.

2. Exchanges will consist or RST plus serial number starting from 001. W/VE/VO stations.

3. Claim 2 points per contact with stations in the same country, 5 points per contact with stations in other countries except W/VE/VO, 10 points per contact with W/VE/VO stations.

4. A multiplier of one (1) is allowed for each State, Canadian province, or country worked.

5. Final score equals total QSO points multiplied by total multiplier.

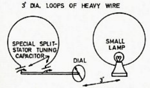
6. Awards will be made to the top-scoring station in each country. Second and third place awards will also be made if the score participation warrants.

7. Send logs to: Contest Chairman, Charles M. O'Brien W2EQS, 190 Knickerbocker Road, Apt. 9, Englewood, NJ, 07631, USA. The mailing dead-line is February 28 ●

THE HISTORICAL DEVELOPMENT OF U.H.F. CIRCUIT TECHNIQUES

(continued from Page 10)

crude wavemeter, using conventional circuit elements, was devised from a low capacitance, split-stator, tuning gang and a single loop of heavy wire. The indicator was a small lamp in series with another loop coupled to the first. An illustration is given in Fig. 4.[8]



5 METRE WAVEMETER FIG. 4

Again, in January 1926, in "QST" an article was published by Harry Lyman. In the article, the author described circuits capable of working at 200 MHz. These circuits extended and refined the principles used earlier by Kruse.[9]

These crude early techniques paved the way for later developments, experiments and use by both Amateurs and research organisations. The techniques developed during this period though, enabled an extension of the usable frequency spectrum to take place up to a frequency approaching 600 MHz. This was achieved mainly through the use of Barkausen type oscillators mentioned previously. ●

(to be continued)

REFERENCES

1. UHF Techniques—Brainerd, Kohler, Reich and Woodruff.
2. Foundations of Modern Physical Science—Holton and Roller.
3. Electric Waves—H. Hertz (1894).
4. Encyclopaedia Britannica.
5. Hyper and Ultra High Frequency Engineering—Sarbacher and Edson.
6. Forty Years of Radio Research—G. C. Southworth.
7. Wireless Over 30 Years—R. N. Vyvyan.
8. "QST" Vol. 8, October 1924.
9. "QST" Vol. 9, January 1926.
10. A Textbook of Radar—Edited by E. G. Bowen.
11. Proc. I.R.E.—Vol. 27, 1939.
12. Reflex Klystrons—J. J. Hamilton.
13. Proc. I.R.E.—February 1947.
14. Masers—J. R. Singer.
15. Microwave Tubes and Semiconductor Devices—Sims and Stephenson.
16. Proceedings of I.R.E. (General, 1955 to 1967).
17. Transistor Manual—General Electric Co.
18. "Amateur Radio" Magazine (General, 1963 to 1969).

VHF UHF
an expanding world

With Eric Jamieson,* VK5LP

Closing date for copy: 30th of month.
Times: E.A.S.T.

VK0	53,100	VK0MA, Mawson.
	53.200	VKOGR Casey.
VK2	52.450	VK2WI, Dural.
VK3	144.700	VK3WI/R6, Vermont.
	144.925	VK3QZ, Traralgon.
VK4	52.400	VK4WI/2, Townsville.
	144.390	VK4WI/R1, Toowoomba.
VK5	53.000	VK5VF, Mt. Lofty.
	144.800	VK5VF, Mt. Lofty.
VK6	52.006	VK6VF, Bickley.
	52.900	VK6TS, Carnarvon.
	52.950	VK6VE, Mt. Barker.
	144.500	VK6VE, Albany.
	145.000	VK6VF, Bickley.
VK7	144.900	VK7VF, Devonport.
VK8	52.200	VK8VF, Darwin.
ZL1	145.100	ZL1VHF, Auckland.
ZL2	145,200	ZL2VHF, Wellington.
	145.250	ZL2VHP, Palmerston North.
ZL3	145.300	ZL3VHF, Christchurch.
ZL4	145.400	ZL4VHF, Dunedin.
JA	52.500	JA1IGY, Japan.
HL	50.100)	
	52.010)	HL9WI, South Korea.

*Forreston, S.A., 5233.

Refer to December, 1972, issue of "Amateur Radio" for listing of additional beacons which may be heard should conditions be suitable, and for television stations sound carrier frequencies.

The current listings of beacons in the New Zealand Call Book show the following as additional operating in that country:— 145.150 ZL1VHW; 431.800 ZL2UHF; the correct call sign for the Palmerston North Beacon on 431.850 is corrected to ZL2UHP.

It would appear the Australian beacon listings will be thrown into some confusion in the future with the proposed changes to call signs as indicated by the P.M.G. Department, so it will be up to the various groups operating the beacons to keep me informed of changes so the beacon listings may be as accurate as possible. It would have been nice to see single letter call signs for the beacons but, as these are not available, the the suggested three letter suffixes will be quite an improvement on the present call signs which include oblique strokes, and listeners now will mainly need to concentrate on getting the call area figure and the last letter to readily identify a particular beacon.

144 MHZ MOONBOUNCE IN VK5.

Congratulations to Chris VK5MC at Hatherleigh, near Millicent, in the south-east of S.A., who has been rewarded for his great efforts by hearing his own 144 MHz CW signals reflected from the lunar surface. Chris first heard his signals on the evening of 24th October, 1972, but was unable to tape the signals due to severe interference from his tape recorder. On 28th October Chris was again successful in hearing his own echoes, and with a different recorder secured 11 minutes of his E.M.E. experiment. Times were 00.24 to 00.35, peaking at 00.32 S.A.S.T. Those hearing the tape have found it very fascinating, with some very clear echoes evident.

Chris is running 100 watts of CW from a 4X150A into four stacked rhombics of 50 wavelengths per leg. Converter has a TIS88 front-end into an early model FR100 receiver, with an active audio filter using IC's, following it — bandpass probably being less than 200 hertz. The first echoes were heard using an MPF121 in the front end, this having to be pressed into service in a hurry as the original TIS88 had been destroyed by an electrostatic charge from the large rhombic array. Adjustments will be needed to the rhombic as it has now been found to be nearly one degree out of the intended position.

This effort is probably the first successful attempt in S.A. and by one of the few actively engaged in E.M.E. experiments. The project was started just after Christmas, 1971, and in less than nine months echoes were heard. Chris would like to thank the Mt. Gambier amateurs, in particular, Trevor VK5TN, for their assistance with the project.

REMEMBRANCE DAY CONTEST

Suppose I will be accused of being smug, but congratulations to VK5 for their effort in winning the contest, looks like a bit of arm-twisting pays off sometimes! Pleased to note also that in at least three States some increased interest was shown by VHF operators. VK2 submitted 7 VHF logs; VK3-6; VK4-15; VK5-18; VK6-1; VK7-24. Perhaps the contest this year was only a trial run for some of the VHF participants, and next year we can hope to see a greater number of submitted logs from all States. In this way we can be assured of keeping some place in the contest in the future.

ROSS HULL CONTEST

By the time you read this most of the Ross Hull Contest will be over, but don't forget to send in your logs to reach the Contest Manager not later than 23rd February, this gives you five weeks. Will be interesting to see what effect the two contacts per day with the same station has on the overall interest.

NATIONAL FIELD DAY CONTEST

The John Moyle National Field Day Contest on 10th and 11th February has been amended sufficiently from previous years to warrant an increase in interest if only to try out some of the alterations. At the moment the idea of separating the true field day stations from mobile stations or stations more or less permanently mounted in vehicles is a good one, and it will be interesting to see what happens.

The Federal Contest Manager, Peter VK4PJ, is certainly putting some effort and interest into the various contests to try and make them more interesting for us all, perhaps we can do a little in return by joining in the contests and ensuring a log is sent in. Anyway, there is still time to get organised for the Field Day.

NOTES FROM HERE AND THERE

A short letter with QSL card from Ron VK4ZLC indicates he is now living in Townsville (probably having moved there for the JA signals!) and reports he is operational on 6 metres AM, 52.525 FM and Channel B, and is building 2 metre gear for the car. 146 MHz activity is not great in Townsville, "but they are working on it."

Also from Townsville comes a letter from Ron VK4ZTK, who reports reception of 6 metre beacons from VK5 and VK8 on the same evening, 13th November. No answers to his calls. Hopes to be quite active on 6 metres this year. Thanks for writing, Ron, perhaps some more general news from the North would help to put you on the map.

Oscar 6 has certainly created quite a lot of interest, and some interesting contacts have been made. Strongest consistent station at this QTH appears to be VK6HK.

REPEATER FREQUENCIES

Appears at present that three States will be making the change in repeater frequencies on 1st February, VK3, 5 and 7, thus confirming the series of motions recently circulated by Federal Executive. New frequences will be:—

Ch. 1 — 146.1 in; 146.7 out.
Ch. 2 — 146.2 in; 146.8 out.
Ch. 3 — 146.3 in; 146.9 out.
Ch. 4 — 146.4 in; 147.0 out.
Ch. 5 — 146.15 in; 146.75 out.
Ch. 6 — 146.25 in; 146.85 out.
Ch. 7 — 146.35 in; 146.95 out.
Simplex Channels: 146.0; 146.45; 146.5; 146.55; 146.65.
National Teleprinter Channel: 146.6.

That's all for this time. Not as much as usual, one reason being I have been completely off the air during the month whilst changing 6 and 2 metre equipment over to SSB operation. Probably the other best reason is that with the earlier time of closing for the copy not so many people have written in time for these notes.

The scope of these notes can be widened if you want it, if anyone cares to write with interesting information on other aspects of amateur radio, such as amateur TV, especially if the information is likely to be of interest to other areas of Australia.

A New Year has dawned, may it be a successful and prosperous one for you all, with plenty of DX, and trouble-free running of your gear. Closing with the thought for the month:— "You could get rich manufacturing crutches for lame excuses."

—The Voice in the Hills. ●

HOW TO PREDICT OSCAR DX

Is the heading of an article in October QST by the managing editor of QST. This features a chart showing the use of low power between 145.90 MHz and 146.00 MHz, and high power outside these limits. He states: "In the low power area signals in excess of 100 W erp will distrupt the normal functioning of the repeater"—"Adjust your frequency, power and antenna so that at no time your repeated signal exceeds the strength of Oscar's 29.45 MHz beacon."

INTRUDER WATCH

With Alf Chandler, VK3LC

I have been alerted to a new kind of Intruder in our bands — Commercials using Amateur Call-signs; 9K2BG, MP4AB and others. With the easy access to Amateur equipment between 0800 and 1300 GMT stations in Kuwait, Saudi Arabia and Dubai (in the Trucial States) are using 14280 to 14350 Khz to pass their commercial, political and part-military traffic using the Arabic language.

Anybody in our fraternity speak Arabic?

The general indifference shown by the majority of Amateurs in a large measure eases the path for these usurpers.

I often wonder what those Spanish speaking stations below 14200 Khz are talking about.

Can anybody give me a translation? ●

*Federal I.W. Co-ordinator, 1536 High St., Glen Iris, Vic., 3146.

"20 YEARS AGO"

With Ron Fisher, VK3OM

TWENTY YEARS AGO, JANUARY, 1953.

Reading through old copies of Amateur Radio, every once in a while, I find an item of unusual interest. Contained in the Federal Notes of the January, 1953, issue, is one such item worth quoting.

"Recording and playback of other amateurs' transmissions". In the past permission had been granted upon application to the Superintendent, Wireless Branch in the State concerned, for 10 amateurs in VK2 and VK3, and five amateurs in VK4, VK5, VK6 and VK7. Under those conditions half of the number in each State was to be composed of Institute members and half non members except that should insufficient applications be received from non members the vacancies could be filled by Institute members.

Rather a quaint ruling. However, from that date, it became possible for any amateur to apply for a permit to record and replay amateur transmissions. The permit was granted provided that the applicant could satisfy the Wireless Branch that the recording equipment was capable of producing recordings of good quality.

The Editorial page extolled the value of the National Field Day contest in its connection with the Civil Defence Scheme and expressed the hope of greater participation. The rules for 1953 had undergone quite a few changes from previous years. Most important was the reduction in duration of the contest to a twelve hour period on the Sunday only. Transmitter power was limited to a maximum of twenty-five watts input. I have often felt that perhaps our present Field Day rules could be improved with the inclusion of a section for low power, home built equipment. These were also the days before the multi operator set-ups moved in.

Technical articles for January included part two of N. Southwell's Phasing Type Single Sideband and Suppressed Carrier Exciter. By the same author, an article on Quarter Wave Matching Stubs Impedance Calculations. D. W. Tacey, VK3DW described his Foolproof Antenna Tuning-Final Loading System. He used a normal parallel tuned set up, but fed the antenna either from one side of the coil, or from the centre point of the split-stator tuning condenser. Results claimed a 200-mile contact on 80 metres with an S8 report using an indoor 30-foot antenna.

Chris Cullinan was at it again, this time with his "Superb 30 watt Modulator". A pair of 807's with inverse feedback provided the power which could be used to modulate the transmitter or act as a Hi-Fi record playing amplifier. Dr. A. F. Taylor, VK3AT, described his approach to FM using a diode modulator. This system was claimed to have several advantages over the reactance tube modulator.

Looking down the list of new call signs, P. J. Healy, VK2APQ, and K. E. Pincott, VK3AFJ. Both names and call signs seem to ring a bell somewhere.

Magazine Index

With Syd Clark, VK3ASC

"73 MAGAZINE"

August (one of Wayne's more interesting issues): Navassa; Slow Scan Television; Premodulation Speech Processor; Two Buck Signal Generator; Transmitters, Then and Now; Practical Amateur FM Repeaters; El Cheape Test Probes; Prog. Line Power Supply; Random Access Switching; Diode Receiver for 432 MHz.; The Taming of the HHRW; $5 Pre-Amp. Compressor; Push-to-Talk for the Sixer; Audio Distribution Panel; Voltage Multiplier Supply for Scopes; VFO Operation for the Twoer; /MM Manoeuvres; The Sun and Radio; Poor Man's Transcanner; SCR Regulator for KW Power Supplies; The Ideal Crystal Oscillator; The HW-16 on Phone; FM Adaptor.

"QST"

September: A Simple Function Generator; Some Plain Facts About Multi-Band Vertical Antennas; A 4000-Channel Two Metre Synthesizer; Four Bands on a Pole; Fundamentals of Solid State Power Amplifier Design, Part 1; The Pip-Squeak gets Smaller; Universal Power Supply for the Amateur Station; Synthesis of a Varicap; A "State of the Art" Approach to Multi-Band FM; Amateur Activity in South Dakota Flood Disaster.

Ionospheric Predictions

With Bruce Bathols,* VK3ASE **JAN. 73**

Here are the Predictions for January 1973 from Charts supplied by the Ionospheric Prediction Service Division.

As from this month, the "Series P" charts have been drastically reduced and have been replaced by "Grafex" charts which are supplied by a computer. These new charts have been specially designed for Amateur frequencies and show predictions for the Bands 7 and 28 MHz.

Predictions from all Australian capital cities to the following areas are available:

Auckland, Cairo, Honolulu, Johannesburg, London (short and long paths), Macquarie Island, Montreal (short and long paths), Moscow, New York, Port Moresby, Rio-de-Janiero, San Francisco, Tokyo and West Africa (short and long paths).

For the purpose of the publication of this information in "Amateur Radio", it must be appreciated that space limitations will curtail the printing of the entire list. However, in the initial stages, I will endeavour to publish all of the countries I have predictions for, and concentrate on the Eastern States where the Amateur population is the heaviest.

Predictions for the 7 MHz. band will be reduced in favour of the higher frequencies, to show their openings as they occur periodically.

Comments from readers on the above remarks would be most appreciated and correspondence should be sent to me at the address shown at the foot of the column.

Use of the F1 mode is shown only, although other modes may extend the openings. All times are GMT.

28 MHz.—				
VK5	to	JA		0100-0800
VK7	,,	VK9		0200-0700
21 MHz.—				
VK1/2	to	SU		0500-1200
,,	,,	G	S.P.	0800-1500
,,	,,	G	L.P.	0900-1100
,,	,,	VE	S.P.	1500, 2000-2400
VK3	,,	UA		0500-1300
,,	,,	W6		2000-0300
,,	,,	PY		0900
,,	,,	ZS		0700-1100
,,	,,	KH6		2000-1000
VK4	,,	W1		1500, 2000-2400
,,	,,	G	S.P.	0800-1500
,,	,,	G	L.P.	0900-1300
VK5	,,	W6		2000-0300
,,	,,	JA		2400-1500
,,	,,	5Z	S.P.	0600-1100
,,	,,	5Z	L.P.	0800-1500, 2000-0300
VK6	,,	W6		2300-0300
,,	,,	PY		1000-1100
VK7	,,	G	S.P.	0700-1200
,,	,,	G	L.P.	1000
,,	,,	VK9		2100-1600
14 MHz.—				
VK1/2	to	ZL		1900-1500
,,	,,	SU		0900-2400
,,	,,	G	S.P.	0700-1500
,,	,,	G	L.P.	0900-1300
,,	,,	VK0		1900-1500
,,	,,	VE3	S.P.	1400-2100
,,	,,	VE3	L.P.	1400-1800, 2000-2400
VK3	to	UA		0700-1500
,,	,,	W6		0400-0600, 1600-2100
,,	,,	PY		0400-1200, 1800-2400
,,	,,	ZS		1200-1700, 2000-2100
,,	,,	KH6		0400-1400, 1800-2100
VK4	,,	W1		1400-2100
,,	,,	G	S.P.	0700-1700
,,	,,	G	L.P.	0800-1200, 2000-2200
VK5	,,	W6		0500-0600, 1600-2100
,,	,,	JA		0600-1600, 2100-2400
,,	,,	5Z		1400-1800, 2100-0100
,,	,,	5Z	L.P.	0500, 0700-2100
VK6	,,	W6		0600, 1600-2200
,,	,,	PY		1700, 2200-0200, 0800-1200
VK7	,,	G	S.P.	0800-1800
,,	,,	G	L.P.	0900-1500
,,	,,	VK9		0500-2300
7 MHz.—				
VK1/2	to	UA		1200-2000
,,	,,	W6		0800-1600
,,	,,	PY		0400-1200, 1800-2300
VK3	,,	G	S.P.	1400-2000
,,	,,	G	L.P.	0900
,,	,,	VK0		0900-1900
VK4	,,	KH6		0800-1700
VK5	,,	ZS		1600-2100
VK6	,,	W1		1000-1400
VK7	,,	SU		1500-2000

* 3 Connewarra Avenue, Aspendale, Vic., 3195.

AWARDS COLUMN

With Geoff Wilson,* VK4MK

Two new awards are now available to Australian Amateurs. The first, to be known as the "Australian V.H.F./U.H.F. Century Club Award", is an extension of the former V.H.F.C.C. Award to cater for the increasing interest in the bands 420MHz. to 2450MHz. It will now be possible under the new rules for an operator to obtain a separate award for each authorized band betwen 52 and 2450 MHz.

The second award, to be known as the "Worked All VK Call Areas (V.H.F.) Award", is similar in character to the WAVKCA award currently offered to overseas HF operators. VHF operators will be required to contact all call areas of Australia from VKI—O on 52 MHz. or above, the number of stations to be worked from each call area being given in the appendix to the rules. This award is considerably more difficult than the present W.I.A. 52 MHz. W.A.S. Award, of which in excess of 100 have now been issued. It is hoped that the new award will stimulate activity especially from VK9 and VKO, and currently a number of stations are active in these areas.

It is noted that the full rules for both these new awards will appear in the new Call Book. Both were set out in full in the 1972 Federal Convention minutes.

CHANGE OF ADDRESS FOR ALL W.I.A. FEDERAL AWARDS

All applications for awards, inquiries, &c., for W.I.A. Federal Awards are to be addressed to the following: "The Federal Awards Manager, W.I.A.", P.O. Box 150, Toorak, Victoria, 3142, AUSTRALIA.

Please do NOT send correspondence to Box 2611W, Melb., Box 67, East Melb., or direct to the home or QTH of the Fed. Awards Mgr.

* 7 Norman Ave., Frankston, Vic., 3199.

HAMADS

FOR SALE

Lafayette HA-600A Communications Rx .15 to .4 MHz and .55 to 30 MHz, AM, CW, SSB, as new, including speaker; $150. E. Cleary, L30286. 11 Magnolia St., Oak Park, Vic., or Phone (work) (03) 61001, Xtn. 1464.

Pye Mk II, with electronic mute, converted with xtls., on 53.032. No PSU, but in working order, circuit available; $25. Rodney Champness, VK3UG, 44 Rathmullen Road, Boronia, 3155, Vic.

VHF Transmitters, two only, 522 VHF Transmitters, 832A. What offers? VK4QS, 6 Robinson St., Belgian Gdns, 4810, Queensland.

Offers desired for Yaesu FL50TX; FR50Rx; FV50 VFO; also surplus components. VK3LV, QTHR.

Heathkit, SB301E, RX with 400Hz CW filter, SB401E TX SB610 monitor scope, coupled to RX and TX SB600 speaker. Some spare valves; $650. Matching units, A1 condition. VK2ZH, ph. (02) 428-2253.

Y.R.C.S.

With Bob Guthberlet*

Greetings to all Supervisors, Club Leaders, Instructors and members. Yes, it's that time of the year. Many clubs will go into recess for the Christmas and New Year period. May all of you have a happy period of rest and relaxation, returning in 1973 to greater success with Y.R.C.S.

Here is something for you to think about. It has been suggested to me that we should eliminate the words "Youth Radio Club Scheme" overprinting from our proficiency certificates and substitute "Amateur Radio Training Scheme". The reason given for the suggestion is that senior members of some clubs might think it beneath their dignity to receive a "youth" award. What is dignity? Some years ago a public speaker said, "Dignity is the starch of the shroud — the more dignity yau have the nearer you are to the grave." Apart from this interpretation there is the question of our new Constitution, in which Clause 3 under objectives states: "To develop in young persons an interest in radio and electronics, etc., etc." My concern is that to substitute the word "Amateur" could be interpreted as an aim to make club members amateurs in the popular usage of the word.

* Federal Co-ordinator, W.I.A.-Y.R.C.S., Methodist Manse, Kadina, S.A., 5554.

BOOK REVIEW

With Syd. Clark, VK3ASC.

"FREQUENCY MODULATION BROADCASTING" Report of the Australian Broadcasting Control Board, June, 1972.

The recommendations are that a Frequency Modulation Broadcasting Service should be set up and that the system consist of National, Commercial and Public Broadcasting Stations operating in a band 40 MHz wide between 470 and 540 MHz.

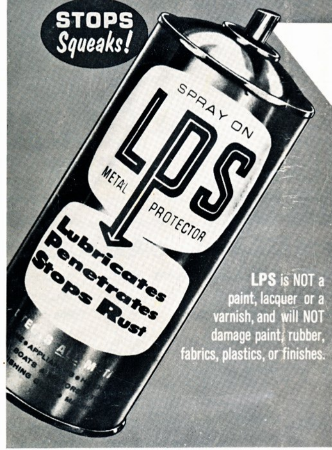
Since the Australian Service will be unique, no recommendations have yet been made as to the technical standards to be used and we may use methods of broadcasting mono, stereo or quad services which differ greatly from those adopted overseas. Whether or not our great-grandchildren will decide we should have put colour TV on UHF and FM on the VHF (88-108 MHz.) band used in the U.S.A. only they will know. By 1977 it should be practical to produce receivers which use a synthesiser technique to lock the local oscillator to a crystal; or a reference frequency transmitted by the FM station. Furthermore, FM broadcasting stations can be employed on a number of services simultaneously without interaction between them.

Now that the ABC has made its recommendations and the Federal Government has indicated that services will commence about 1977 it is up to industry to ensure that the Australian Service is superior to similar services which already exist.

STOP RUST OUTDOORS TWO YEARS . . . OR MORE!

Lubricates Penetrates Stops Rust

DRY YOUR ELECTRICAL SYSTEMS with LPS — the NON-GREASY ONE



Displaces Moisture Fast!

TECHNICAL INFORMATION

Physical Properties:

LPS 1

Less than 0.0001 inch non-greasy molecular film with capillary action that spreads evenly and easily to seal out moisture at very low cost.

Rust Inhibitor: Protects **all** metals from rust and corrosion.

Water Displacing Compound: Dries out mechanical and electrical systems fast.

Lubricant: Lubricates even the most delicate mechanisms; non-gummy, non-sticky; does not pick up dust or dirt.

Penetrant: Penetrates to loosen frozen parts in seconds.

Volume Resistivity per ASTM D-257: Room temperature, ohm/cm.; 1.04 x 10^{12}.

Dielectric Constant per ASTM-877:
Dielectric Constant 2.11, Dissipation Factor: 0.02.

Dielectric Strength per ASTM D-150:
Breakdown Voltage 0.1 inch gap, 32,000 volts.
Dielectric Strength volts/inch, 320,000 volts.

Flash Point (Dried Film), 900 degrees F.
Fire Point (Dried Film), 900 degrees F.

TESTS AND RESULTS: 950 degrees F.

Lawrence Hydrogen Embrittlement Test for Safety on High Tensile Strength Steels: Passed. Certified safe within limits of Douglas Service Bulletin 13-1 and Boeing D6 17487.

Mil. Spec. C-16173 D-Grade 3, Passed.
Mil. Spec. C-23411, Passed.

Swiss Federal Government Testing Authority for Industry: Passed 7-Day Rust Test for acid and salt water. Passed Weiland Machine Test for Lubricity as being superior to mineral oil plus additives.

LPS Products conform to Federal Mil. Specs. C-23411 and/or C-161730

HOW LPS SAVES YOU TIME AND MONEY

1. LPS PROTECTS all metals from Rust and Corrosion.
2. LPS PENETRATES existing rust—stops it from spreading.
3. LPS DISPLACES moisture on metal—forms fine protective film.
4. LPS LUBRICATES even the most delicate mechanisms at extreme temperatures.
5. LPS PENETRATES to free rust frozen parts, nuts, bolts, etc.
6. LPS PREVENTS equipment failures due to moisture (drives it out).
7. LPS LENGTHENS LIFE of electrical and electronic equipment—improves performance.
8. LPS RESTORES equipment damaged by water contamination and corrosion.
9. LPS PENETRATES AND PROTECTS plated and painted metal surfaces.
10. LPS PROTECTS metals from salt atmosphere, acid and caustic vapours.
11. LPS LOOSENS dirt, scale, minor rust spots and cleans metal surfaces.
12. LPS ELIMINATES squeaks where most everything else fails.

Sole Agents:

ZEPHYR PRODUCTS PTY. LTD., 70 BATESFORD ROAD, CHADSTONE, VIC., 3148. Phone 56-7231